The Gulf Coast Today . . .

OIL AND GAS JOURNAL

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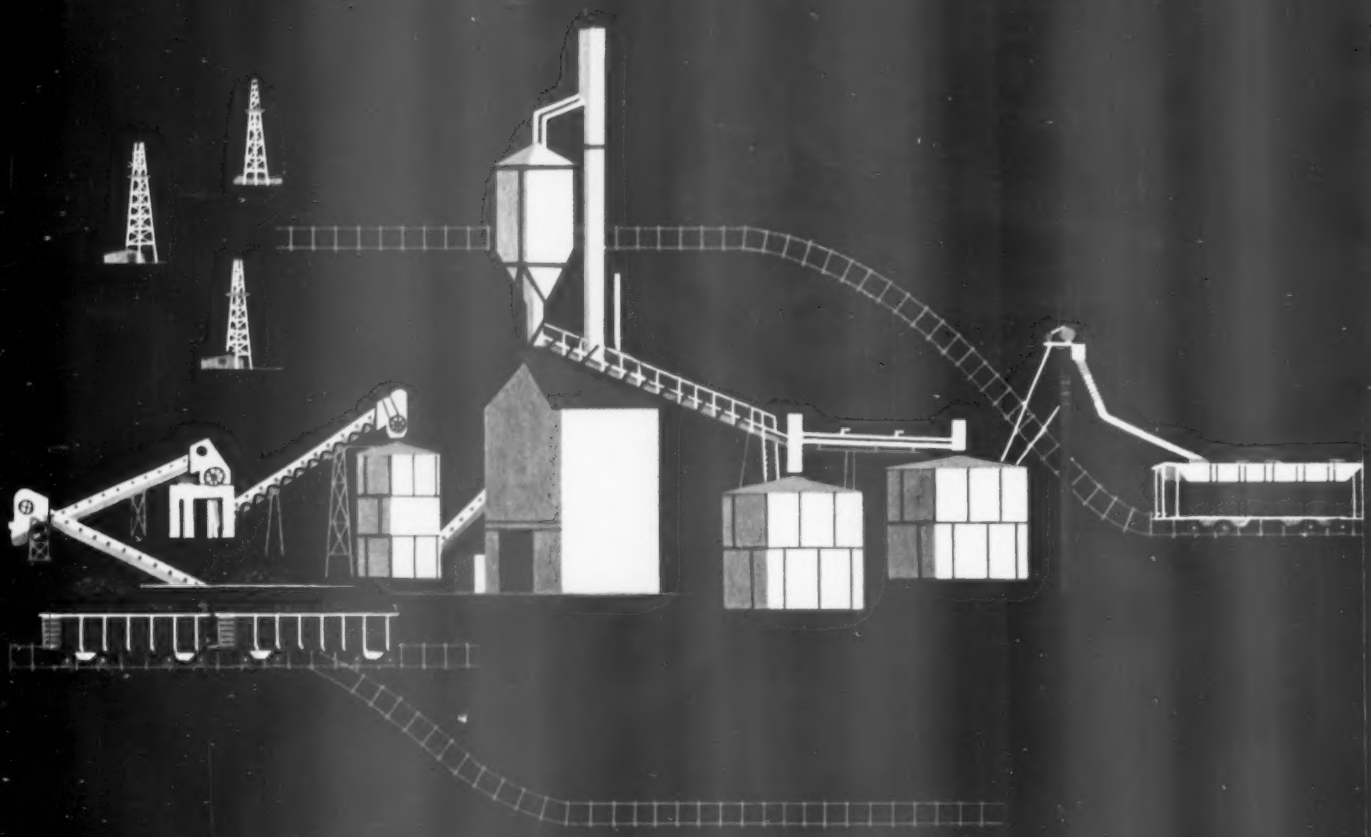
AR-608

PRICE 50 CENTS TABLE OF CONTENTS ON PAGE 1 **JUNE 22, 1953**

POZMIX



1000 YEARS NEW!

The Aztecs knew it by another name and Roman ruins reveal its use. Their buildings, still standing, are monumental proof of the permanence of pozzolans. Now this centuries-old cementing material again makes history as a great new development in production improvement. That's because Halliburton, in its unceasing search for better ways to serve you, found that the time-tested toughness of pozzolans could be mixed with portland cement to make oil wells as durable as the Aztec temples. Before this important discovery was announced Halliburton built a huge plant in El Paso to process Pozmix. Only then was the industry told about it. And, just months later, the millionth sack of Pozmix was used to make oil well cementing more secure. So broad is the scope of Halliburton's research that it looks back across the centuries for a new idea in progress.

HALLIBURTON OIL WELL CEMENTING CO., DUNCAN, OKLAHOMA

"PERPETUAL PROGRESS IN PRODUCTION IMPROVEMENT TECHNIQUES"

the OIL AND GAS JOURNAL

JUNE 22, 1953 VOL. 52 NO. 7

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In Brief . . .

1. LOCATING LOST CIRCULATION . . . An effective temperature-survey method for locating zones of lost circulation has been developed. The method is economical, in that great quantities of drilling mud are not required. Definition of the lost-circulation zone is necessary when resort is made to one of the several "squeezing" techniques, such as cement, time-setting clay cement, bentonite-diesel oil squeeze, and others. Principle of the method is that when loss of circulation occurs, mud is displaced from the surface, down to the point of loss, while mud below the point of loss is undisturbed. This causes a decrease in temperature down to the point of loss. Below the loss, the mud temperature remains unchanged.

•

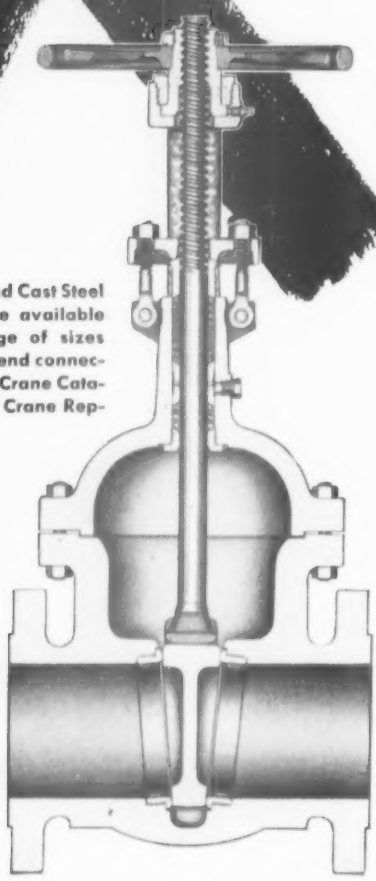
2. OFFSHORE LOUISIANA . . . Louisiana's offshore production at the beginning of 1953 was from 120 oil wells, with a daily production of 22,028 bbl., plus 25 gas wells. The majority of the latter have been shut in due to lack of gathering facilities. Almost 20 million barrels of oil have been produced since the first offshore well was brought in in 1947 in the Ship Shoal area off the coast of Terrebonne Parish. By January 1953, 233 wells had been drilled in Louisiana offshore areas, resulting in the discovery of 28 oil or gas fields. There are 13 companies engaged in operations in these fields.

•

3. BETTER GRAVEL PACKING . . . Improvements in operations and procedures have made gravel packing an economical and effective method of controlling sand production and permits in part the exclusion of water and gas from the oil production. Principal factors that brought about the recent improvements are the use of clean fluid when placing the gravel fracturing formation with acid, the use of finer gravel than that previously used (or theoretically required), and the placing of all the gravel in one stage.

X Marks a BIG Difference

IN 300-POUND STEEL GATE VALVES



Crane 300-Pound Cast Steel Gate Valves are available in a wide range of sizes with 3 different end connections. See your Crane Catalog or call your Crane Representative.

There's a lot of pioneering wrapped up in Crane 300-Pound Cast Steel Wedge Gates—pioneering that helped set the high quality standards every modern steel valve must meet.

Take Crane *Exelloy*—"X" trim—for example. In the early days of oil refining, many metal and metal combinations were tried for seating surfaces and found wanting. Crane *Exelloy*, adopted more than 25 years ago, set a new record of usefulness and satisfaction. So remarkable was its performance that this class of material (roughly designated as 11½ to 13 per cent chrome) became the recognized staple valve trim in the petroleum industry.

And yet, Crane still manages to come up with "X" trim of superior quality. It's done with bars and billets that meet the most rigid specifications—and manufacturing techniques that develop the best characteristic of material for each component part.

And it's you, the Thrifty Valve Buyer, who benefits from Crane Co.'s pioneering experience. You get better quality steel valves—quality that keeps up performance and holds down maintenance costs.

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
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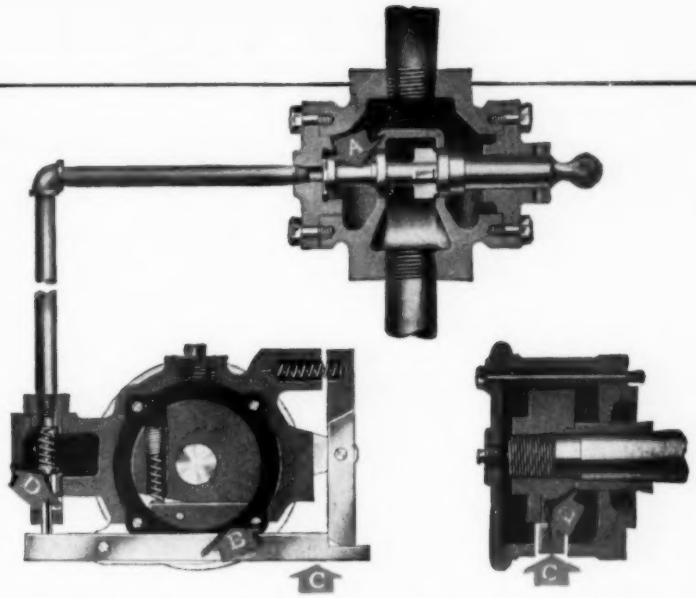
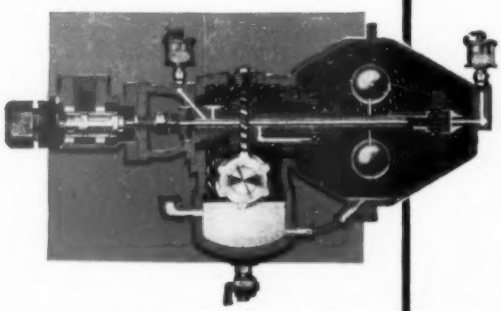
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

The Oil and Gas Journal, published Mondays, copyright 1953, by The Petroleum Publishing Company. Entered as second-class matter September 1, 1910, at post office at Tulsa, Okla., under act of March 3, 1879. U. S. and foreign rates to the petroleum industry, $4 yearly.

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

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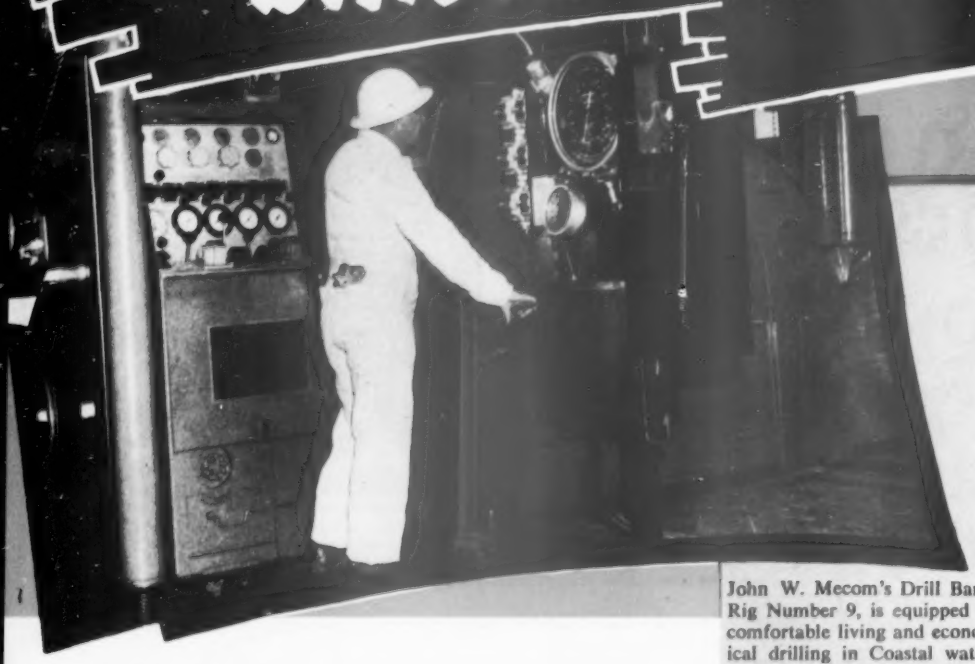
WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 267 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

This is the 20th "Oilwell" Power Rig for BARGE DRILLING



John W. Mecom's Drill Barge, Rig Number 9, is equipped for comfortable living and economical drilling in Coastal waters. An "Oilwell" No. 96 Draw Works with No. 1500 Drive and No. 15 Brantly Hydraulic Automatic Drilling Control, together with other "Oilwell" companion equipment, provides dependable facilities for drilling under the most isolated conditions.

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The farther you operate from established service centers . . . whether it be barge work along the Gulf Coast, or wild-catting in Alaska . . . the more you benefit from the extra "margins of safety" that are built into every piece of "Oilwell" Drilling Equipment.

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USS

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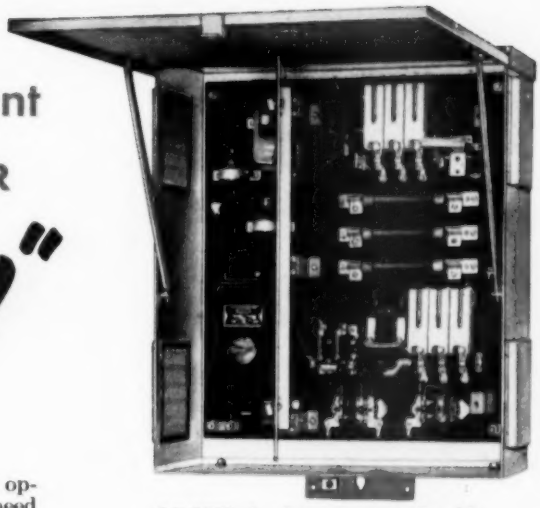
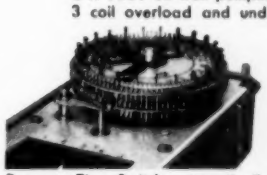
TRADE MARK

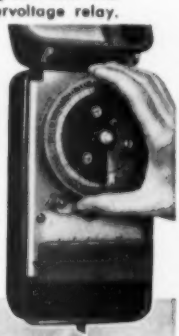
UNITED STATES STEEL

We give you what you want in genuine CUTLER-HAMMER "Oil Country" well pumping control



C-H 9589 oil well pumping controller with 3 coil overload and undervoltage relay.





Program Time Switch automatically schedules pumping, set up easily by pull tabs—one for each 15 minute interval. Day omission feature also available, for non-operation any selected days of week.

Cutler-Hammer went to the oil country to find out what oil operators, practical production men, maintenance crews really need and want in their oil well pumping control.

And Cutler-Hammer Oil Country Control *proves out*. The practical way in which heat is shielded out and fresh clean air pours in around the working mechanism proves out. You never see C-H control with the door propped open to keep it working.

The extraordinary care to keep out dirt, large particles of dust and bugs proves out. Louvres, bronze-screening and baffle plates do their work. And the famous C-H Vertical dust safe contacts shed dirt and dust to keep clean, sure contacts. Timer is neoprene-gasketed and dust proof. And the excess torque time clock keeps going if inadvertently dust gets in.

Undervoltage relay if you want manual restarting. Automatic time delay if you want automatic staggered starting of groups of motors.

Full three phase protection with 3 coil overload relays if you want to avoid motor burnouts which can result from single phasing.

Pumping sequence changes are made in 15 minute increments. You just pull small, accessible tabs. Day omission feature is also available on the time programming switch when your scheduling calls for skip-a-day pumping.

Unit type lightning arresters that tell at a glance if they've blown and eliminate the need to clean up or rebuild the starters.

There are so many wanted features on these controllers, there is not room enough to tell them all. Ask for further information. Or better still, try out a C-H starter and compare it with the performance of any other make you have ever had. CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.

CUTLER-HAMMER
MOTOR CONTROL
C-H

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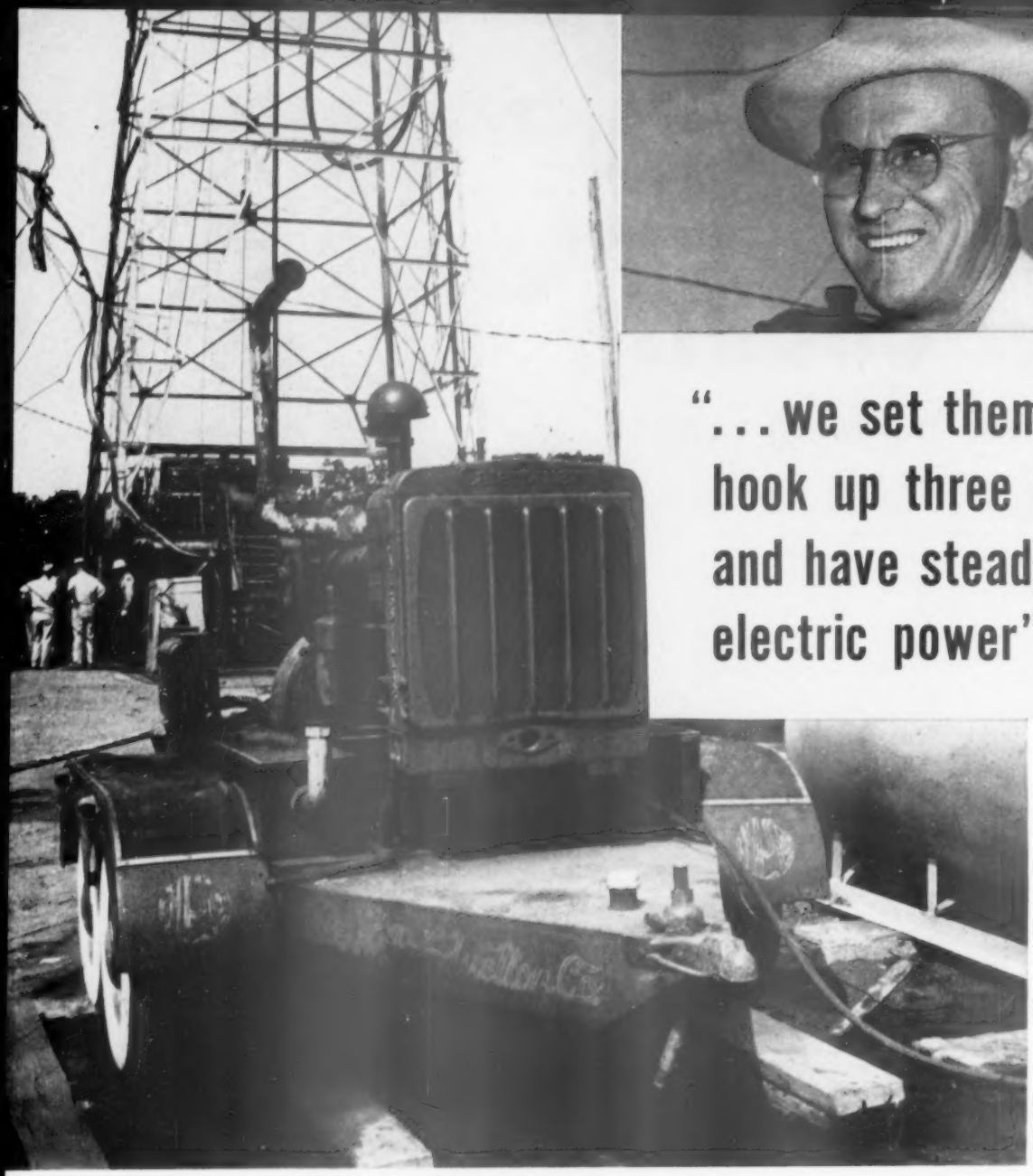
"...we set them up, hook up three wires, and have steady electric power"



So says E. S. Parker, drilling superintendent of West Production Co., Houston, Texas, about his Cat* D4400 Electric Set. It develops 20 KW for rig lighting and two-way radio communication between the rig and the main office. And it's tough, rugged, dependable—working 24 hours a day every day of the month when drilling is in progress. The electric set now has well over 14,000 hours on it!

There are 12 sizes of engines and electric sets, ranging up to 500 HP and 315 KW. They're simple in design and construction, portable, and economical. Leading manufacturers can supply these engines to power their oilfield equipment.

Your nearby Caterpillar Dealer can show you how these oilfield engines can earn extra profit on your rig or pumping job. Call him—let him show you proof of performance.

Caterpillar Tractor Co., Peoria, Illinois.

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NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

REALLY EARNS ITS TIME-SAVER TITLE!

HALLIBURTON'S DUMP BAILER SERVICE

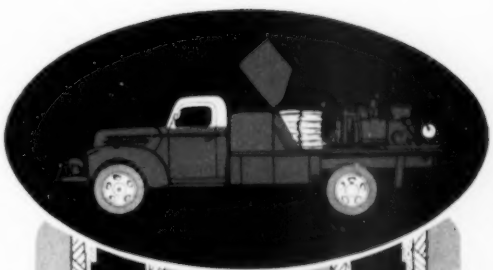
Milling out a section of securaloy pipe in the casing string *used* to be quite a job. Took two or three days. Now – Halliburton's Dump Bailer Service can place a solution downhole in large enough quantities to dissolve the aluminum pipe in about *eight hours.*

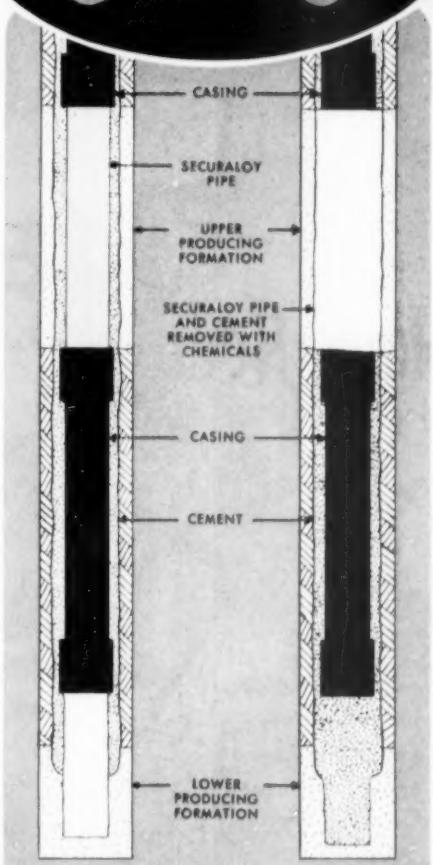
The formation is ready for production that much quicker.

Yet this is just one of many urgent well problems that can be solved by using Halliburton's Dump Bailer Service. Small wonder that this all-around performer – the service that handles well problems with maximum effectiveness in minimum time – continues to gain in favor with operators.

Halliburton's Dump Bailer Service can place quick-setting Cal-Seal for nitro tamps; bridge pipe for repairs; plug back bottom of hole; shut off water, and solve additional remedial problems.

To learn how this service can save you time and money; to get the big experience of trained specialists, simply phone your nearby Halliburton representative. Or contact Halliburton Oil Well Cementing Company, Duncan, Okla.





USE AND REMOVAL OF SECURALOY PIPE

YEARS AHEAD IN REMEDIAL SERVICING!

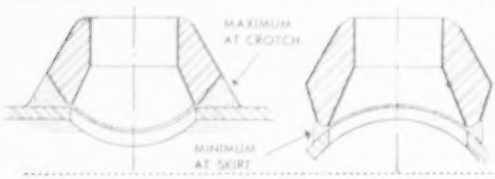
HALLIBURTON

WELDOLET WELDING FITTINGS
MEAN PERMANENT PIPING
. . . PERMANENT SAVINGS

Here's Why

Every fitting is shaped to fit the pipe and is self-aligning.

The template is the inside of the fitting. The hole in the run-pipe can be cut out either before or after the fitting is installed.



Welded as indicated—to fill in 50° bevel at crotch, blending into 35° bevel at skirt—full reinforcement is accomplished.

The outlet is machine-beveled for quick, easy butt-welding of the branch pipe—shop or field fabrication.

Here's How

1. The WeldOlet is raised off the run pipe to establish proper weld gap, as required by Code for all types of branch connections. This is accomplished by placing spacers, e.g. welding rods, under the fitting.
2. The base joint is tack welded, preferably at four points, each half way between the crotch and skirt sections of the fitting. The spacers are then removed.
3. The stringer bead—or beads—is applied completely around the base of the fitting. The established weld gap assures full penetration.
4. Additional passes are applied as necessary to fill in the tapered base bevel of the fitting. The intermediate passes should not be continuous. Re-inforcing welds should be made at the crotch bevel area at each side of the fitting only. A continuous cover bead should be added, filling the bevel at the base of the fitting at the crotch and skirt sections.

TO COMPLETELY SAFEGUARD AGAINST:

- high pressures
- high temperatures
- internal corrosion
- external stresses

TO PROVIDE:

- improved fluid flow
- trouble-free and permanent piping systems

TO ACCOMPLISH ALL THESE THINGS IN THE MOST ECONOMICAL MANNER . . . SPECIFY AND USE

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Receding Mechanism Guarantees Tapered Pipe Threads To Closest Tolerances . . .

. . . one of the many exclusive features of Landis Receding Chaser Pipe Threading & Cutting Machines. Through this taper attachment the die head is opened on diameter as the thread is being cut, and the thread-cutting chasers recede at a rate equal to the taper of the thread being cut.

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For information on the many other features of Landis Pipe Machines, designed to produce threads to meet the high standards demanded by users of high pressure pipe and oil tubular goods, write for Bulletin C-77.

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(EJECTORS • EDUCTORS • EXHAUSTERS • SYPHONS)

Often the MOST ECONOMICAL and EFFICIENT WAY to Transfer and Mix Fluids

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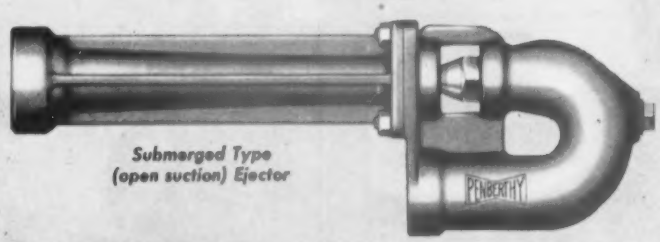
Standard Ejector for Steam or Air Operation

Standard Hydraulic Ejector

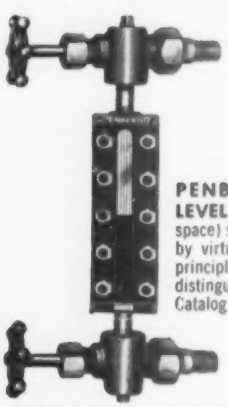
Stainless Steel Jet Pump for Handling Corrosive Chemicals



Submerged Type (open suction) Ejector

WRITE FOR *New* BULLETIN No. 512

OTHER PENBERTHY PRODUCTS



PENBERTHY TRANSPARENT LIQUID LEVEL GAGE—Used to observe color and density of liquids under high pressures and/or temperatures. Exceptionally sturdy construction—liquid chamber machined from solid block of metal. Ask for Catalog 35.

PENBERTHY REFLEX LIQUID LEVEL GAGE—Empty space (or steam space) shows white and liquid shows black by virtue of a simple, unvariable optical principle. Accurate reading as far as you can distinguish black and white. Write for Catalog 35.

PENBERTHY AUTOMATIC INJECTOR—Will supply feed water to boiler at minimum cost. Quickly, easily installed, reliable under most severe operating conditions. Ask for Bulletin 513.

4731

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DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

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Established 1886

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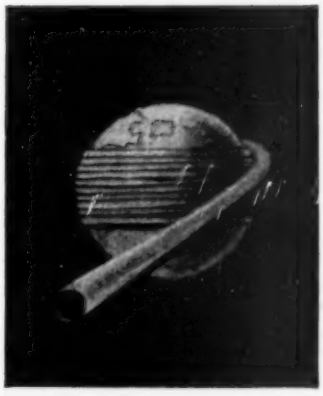
Canadian Plant—Windsor, Ontario

600 000 000 t

of oil are used in the world every year — a figure that must be seen to be grasped. Imagine a pipe line 48 inches in diameter running 16 times around the earth, or in other words 1,15 million miles long. Our whole way of living and the very maintenance of modern civilization depend on that amount of oil. The struggle to obtain it is a tremendous and continuing one, for consumption keeps climbing without a pause. Mannesmann bears its share in the assault on oil. Only the seamless steel tube made it possible at all to drill thousands of feet down for liquid gold. Mannesmann drilling rigs are fetching up oil all over the world today, and pipe lines of Mannesmann steel tubing carry it away. To the refineries, which are practically one huge system of tubing, we supply pipes, safety valves, and fittings. The universal confidence in Mannesmann products for the petroleum industry is based on experience in oil fields the world over.



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WHELAND

350 Horsepower

HP-14000 7½" x 14"

DUPLEX SLUSH PUMP

is the pump for

JET DRILLING!

IT MUST BE FITTED WITH

Proper size liner and run at correct speed and pressure

IN RELATION TO

1. Size, condition, and depth of hole
2. Type and size of drill pipe, drill collars and jets in bit

TRADE WHELAND MARK

DATA SHEETS compiled from actual performance of jet drilling with Wheland HP-14,000 are available on request

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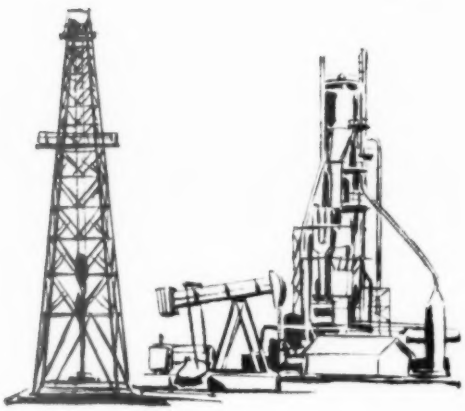
DRAW WORKS • SLUSH PUMPS • ROTARIES • SWIVELS • CROWN BLOCKS • TRAVELING BLOCKS

IVERSON SUPPLY CO.

C O.

OIL WELL SUPPLIES

WHEN THE CHIPS ARE DOWN- YOU CAN ALWAYS DEPEND ON IVERSON



EQUIPMENT FOR
DRILLING • PRODUCTION • REFINING

Drawwork failure gobbling up drilling schedules? Or maybe you need new balls, seat or working barrels quick. Whatever your problem, remember *"When the chips are down — you can Always depend on Iverson."*

Iverson does everything possible to fill your drilling, production or refinery equipment needs — from making special trips to hard-to-reach drilling locations to making special night deliveries. The next time equipment failure threatens your operations, call Iverson. A fully-stocked Iverson store is near you.

STORES:

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OFFICES: FORT WORTH TEXAS

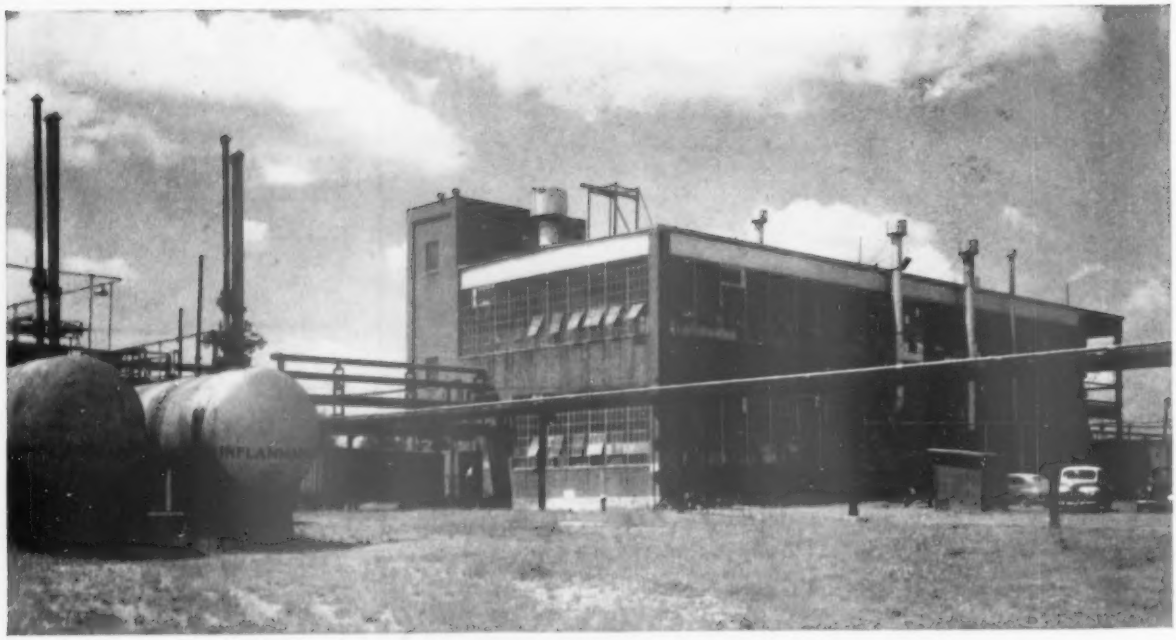
IVERSON SUPPLY COMPANY

DRILLING-PRODUCTION AND REFINERY EQUIPMENT

P. O. BOX 1439 TULSA 1, OKLA.

OFFICES: MIDLAND TEXAS

Oh, I see



. . . they're using

our valves at

GOODYEAR

The Goodyear Chemigum Plant at Akron relies on perfect valve functioning . . . precise flow control with valves that are dependable, just as you may. Their choice throughout this plant is OIC.

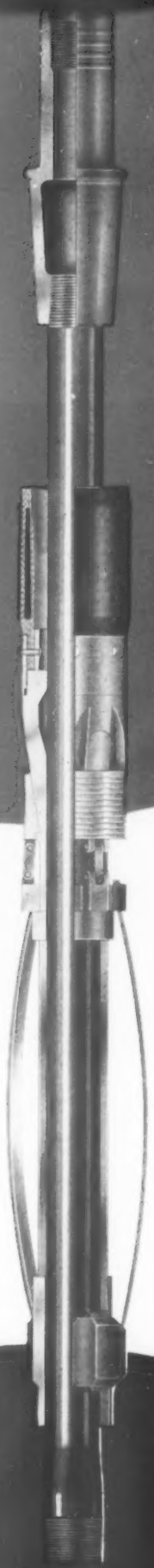
You pay no extras for OIC's precision engineering, even though you do get longer, trouble-free valve service. In addition, OIC offers you engineering assistance to help you select valves best suited for the job.

If you could see them made, you'd make OIC Valves your first choice when you want dependability.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC FOUNDED 1883

VALVES | **FORGED & CAST STEEL, IRON & BRONZE, LUBRICATED PLUG VALVES**



AMERICAN IRON'S

NEW TYPE S

Control Head Packer assures

- POSITIVE SEAL
- POSITIVE SETTING
- POSITIVE RELEASE

AT ANY DEPTH

Once you've used this new Type S Packer, you'll agree that here is the outstanding packer for extremely deep, hazardous wells! For example, even in those difficult off-center wells where the tubing rides the casing wall, this new packer is designed to set, seal and release with dependable, positive action!

You get positive seal because this Type S Packer is equipped with American Iron's specially designed, patented packer cup — used so successfully on all American Iron Packers. Heavy-duty dovetail slips provide positive setting with assured release at any depth! Feature by feature — you'll find that this new Type S Packer is the sum-total of all our many years experience in designing and manufacturing packers!

Send for special TYPE S PACKER BULLETIN now available upon request.

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MANUFACTURERS OF A OIL FIELD EQUIPMENT
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Photo by permission of Reconstruction Finance Corp., Neches Butane Products Co. and The Lummus Co., Contractor.

Raymond... DEEP IN THE HEART OF TEXAS

DRIVING RAYMOND STANDARD PILES AT PORT NECHES PLANT OF NECHES BUTANE PRODUCTS COMPANY

When Neches Butane Products Company of Port Neches, Texas, planned a recent expansion program, the contract for the piles was awarded to Raymond. A total of 799 Standard Raymond Piles was placed at this plant.

Raymond has been privileged to serve many of the oil companies of the U. S. and their affiliates. A wide geographical distribution of personnel and equipment enables Raymond to give prompt and efficient service anywhere in the country.

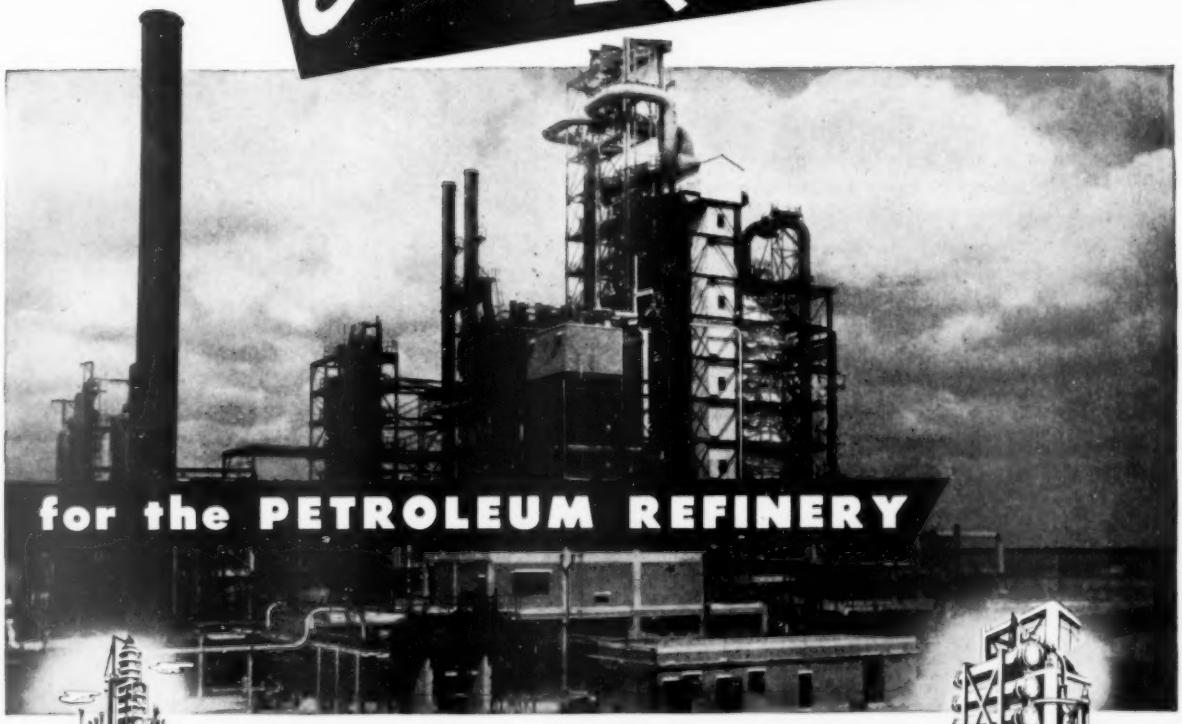
THE SCOPE OF RAYMOND'S ACTIVITIES—
Soil Investigations . . . Foundation Construction . . . Harbor and Waterfront Improvements . . . Prestressed Concrete Construction . . . Cement-mortar In-Place Lining of Water, Oil and Gas Pipelines.

Raymond
CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

BRANCH OFFICES in principal cities of the United States and Central and South America

Essential EQUIPMENT



TOWERS—STILLS

STEAM BOILERS

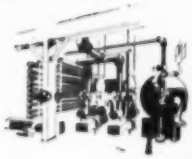
DROP FORGED STEEL VALVES AND FITTINGS

SELECT the process most suitable to your operating conditions and indicated future market requirements and then specify . . . Equipment by Vogt.

A wealth of research and engineering experience, combined with skilled operating personnel and exceptional manufacturing facilities, is incorporated in the wide variety of equipment we construct to all Codes.

Inquiries for detailed information on Vogt Products will receive prompt attention.

HEAT EXCHANGERS



REFRIGERATION MACHINERY

WAX PLANT EQUIPMENT

HENRY VOGT MACHINE CO., Inc.

LOUISVILLE 10, KENTUCKY

NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • ST. LOUIS • CHARLESTON, W. VA. • DALLAS

THESE SPEED INCREASERS

have the permanent ruggedness needed for temporary service

Farrel® speed increasers are ideally suited to withstand the rigors of temporary service such as this. Their inherent ruggedness assures smooth power transmission under the most adverse conditions—continuous day and night operation, dust, rain, sandstorms, severe heat and intense cold.

Features of these units include precision generated gears that operate efficiently through long years of service . . . a completely self-contained circulating oil system that virtually puts power on velvet . . . extra large precision-ground shafts . . . oversize, accurately finished bearings . . . and an exceptionally rigid housing.

Farrel speed increasers are available in 49 standard sizes, with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

Send for full information. Ask for a copy of Bulletin No. 448A.

Four skid-mounted Caterpillar Diesel engines driving Byron-Jackson pumps through Farrel speed increasers at one of two temporary stations of Interstate Pipeline Company between Sunset, Texas and Baton Rouge, La. Four similar Farrel units are in operation at the other station.

FARREL-BIRMINGHAM COMPANY, INC.

ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

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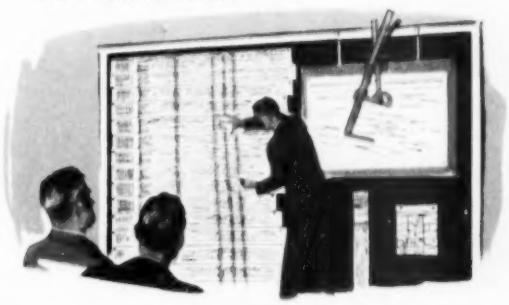
Farrel-Birmingham®

FB-751

SEI

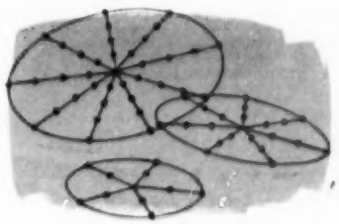
EXPERIENCE



INTERPRETATION

For twenty-one years, SEI has specialized in sub-surface studies of the domestic oil provinces . . . from Canada to the Gulf. Numerous innovations in instrumentation, interpretation, and field technique have kept SEI in the forefront. For example, in difficult areas, SEI has been a pioneer in the use of patterns of multiple shot holes and geophone arrays.

Your exploration program is in capable hands at SEI.



TECHNIQUE

SEISMIC EXPLORATIONS INCORPORATED

1007 SOUTH SHEPHERD • HOUSTON, TEXAS

Close Inspection

This cat picture makes us think of the final inspection of Midwest Welding Fittings. It is equally intense, searching, eye-on-the-ball type. Such final inspection is only one of an exhaustive series of continuous controls and checks that play an important part in assuring the high quality and uniformity of all Midwest Welding Fittings. You can cut your welded piping costs by specifying Midwest Welding Fittings.

A corner of the Final Inspection Department where every Midwest fitting is individually checked for concentricity, uniformity, and dimensional accuracy. Such checks are the last of a series conducted during production.

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Plants: St. Louis, Passaic, Los Angeles and Boston
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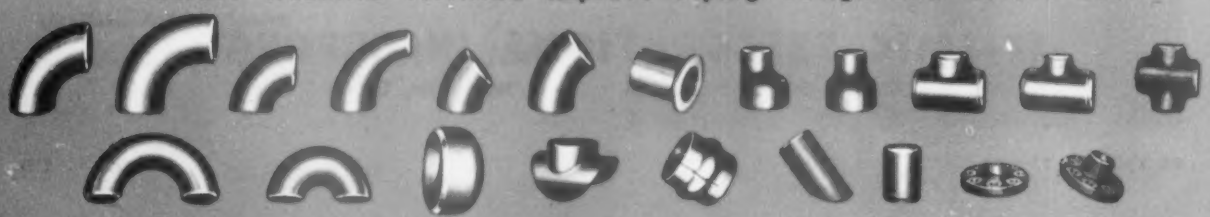
MIDWEST WELDING FITTINGS

6104

MIDWEST WELDING FITTINGS Improve Piping Design and Reduce Costs

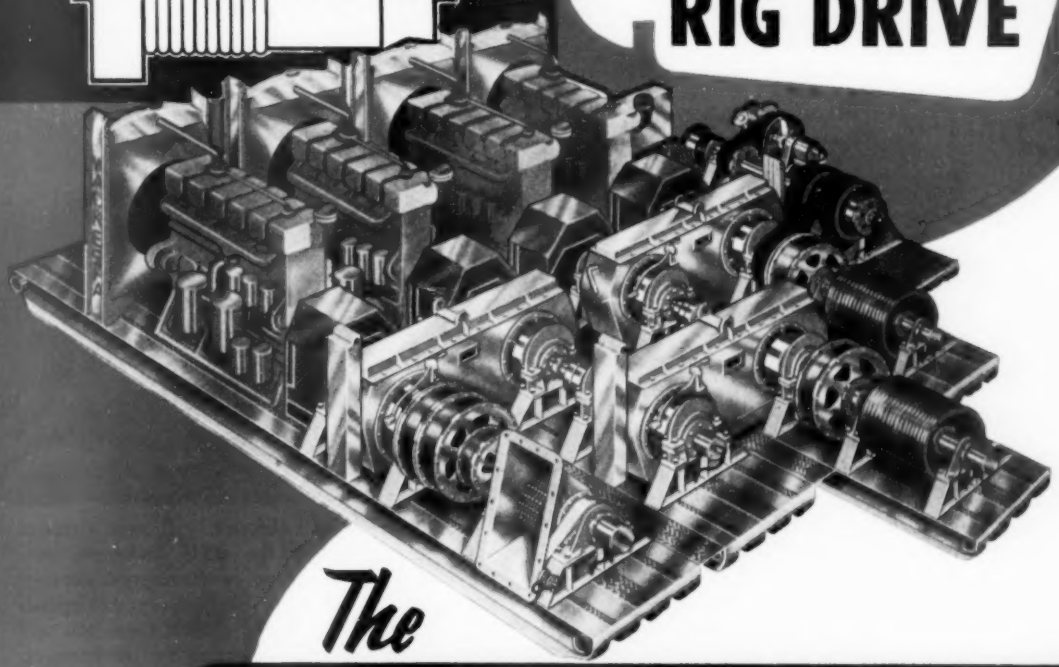


AS SHOWN AT OIL SHOW

ANY ENGINE

ANY DRAWWORKS

MID-CONTINENT
RIG DRIVE



The
MID★CONTINENT
Swinging Compound
Rig and Pump Drive Group
...for Any Engines

This booklet available on request.

MID-CONTINENT
Supply Company

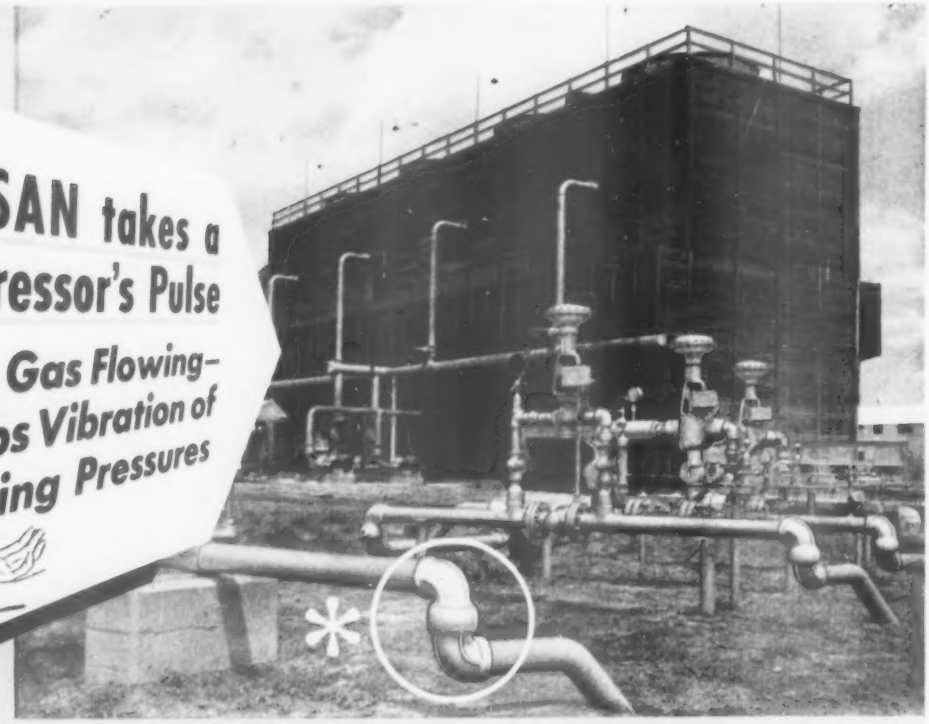
General Offices Mid-Continent Building FORT WORTH, TEXAS

The Answer to Drilling Power Problems with Any Combination of Power, Drawworks and Pumps

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

CHIKSAN takes a Compressor's Pulse

Keeps Gas Flowing— Absorbs Vibration of Changing Pressures



NOT only do the stamina and flexibility of Chiksan Joints take expansion in their stride, they absorb pulsation and vibration.

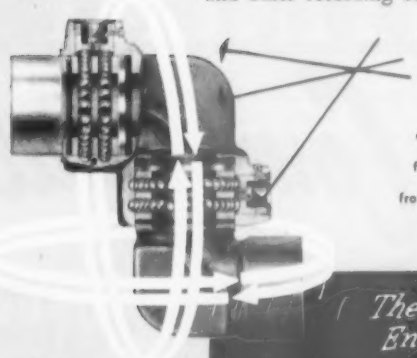
When the Plymouth Oil Company wanted a better way to handle the expansion and contraction of its 2500-3500 lb. natural gas re-pressuring line in its compressor station in Sinton, Texas, back in 1946, it tried Chiksan 2-inch high pressure ball bearing swivel joints. So successful were Chiksan Joints in this application, they were adopted for 3 and 4-inch lines for the same purpose. In addition, by placing regulators, gauges and other recording equipment on a bridge using Chiksan Joints, accurate readings of the instruments could be obtained.

Since 1946, not one of these Chiksan Joints has been replaced or even repacked, and they are giving the same economical, dependable service they did when first installed.

In Texas or California — all over America and all around the world — wherever production, processing or distribution depends on the flow of liquid or gas or on the dependability of hydraulic systems, there you will find Chiksan Ball Bearing Swivel Joints on the job — adding muscle and flexibility — cutting down on shut-downs and maintenance.

Whatever your business, if gas or liquid plays a part, Chiksan's Research and Development Division can help you add efficiency, safety and economy to your operation.

Representatives in Principal Cities
Write for Catalog 53-C, Dept. OGJ-6.



CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry — with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles and sizes have been developed for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 75° to a plus 500° F. with packing materials for each specific type of service.

CHIKSAN TRADE MARK REG.

The Flow of Enterprise Relies on **CHIKSAN** *Ball-Bearing Swivel Joints*

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How To Make J&L Service More Valuable To You

J&L supply service extends from the continental divide to the Atlantic seaboard, but in every field that service is cut to a pattern that fits. You can help us keep it that way.

Drillers, producers, pipeliners and refiners who ask for what they want and expect us to have it are the men who pinpoint J&L service.

We cordially invite YOU to help determine our inventories, influence our manufacturers, and mold our policies to the end that you may say with growing pride and confidence in your near-by J&L supply store "...here's MY warehouse!"

On the Gulf Coast, too, J&L pinpoints service

Hip boots are seldom worn in Texas, and cowboy boots are not too popular in Louisiana and Mississippi.

In the oil business along the Gulf Coast locale makes a difference, too. We recognize and respect these differences. We want store stocks and reserve facilities to reflect accurately the needs of the industry at hand. Your inquiries are important to us. Keep them coming!

JONES & LAUGHLIN STEEL CORPORATION
SUPPLY DIVISION

J&L STEEL

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88 STORES • 19 OFFICES • 9 RESIDENT SALESMEN

EXPORT: 405 Lexington Ave., New York, N. Y., U. S. A.

wherever flow control is important

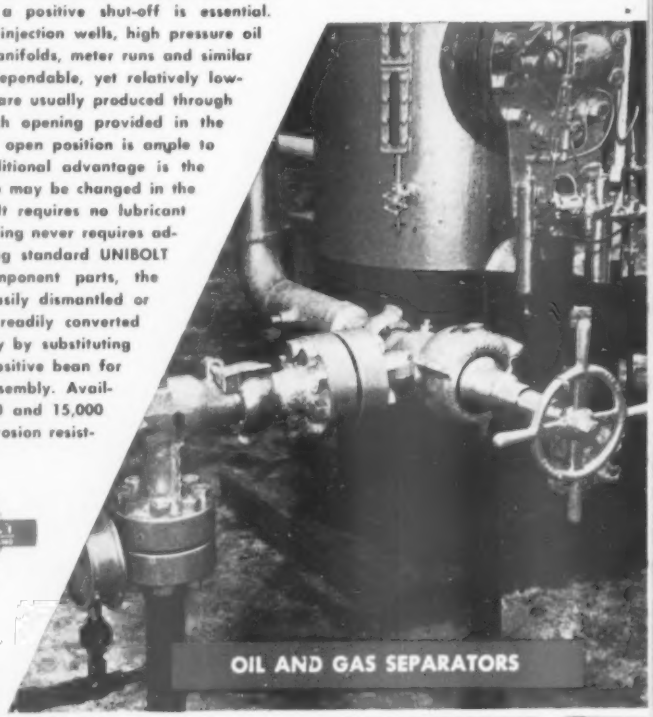
UNIBOLT

adjustable wing valves

are your best bet !

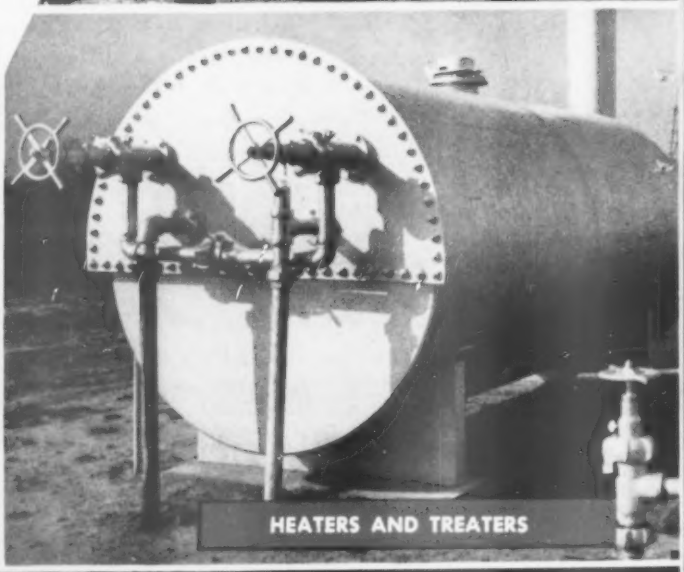
The UNIBOLT Wing Valve, designed originally for use as an adjustable choke where well conditions did not demand a positive choke, has become popular with production men as a dependable valve for numerous services where a positive shut-off is essential. Christmas trees for both producing and injection wells, high pressure oil and gas separator manifolds, heater manifolds, meter runs and similar services are made to order for this dependable, yet relatively low-cost valve. Since high pressure wells are usually produced through a small positive choke, the one-inch opening provided in the UNIBOLT Wing Valve when in full open position is ample to assure unrestricted flow. An additional advantage is the replaceable stem and seat, which may be changed in the field, easily and at low cost. It requires no lubricant to effect a seal. The stem packing never requires adjustment or tightening. Having standard UNIBOLT Couplings between its component parts, the UNIBOLT Wing Valve is easily dismantled or assembled, and may be readily converted to a Positive Choke Body by substituting a blanking plug and positive bean for the stem and seat assembly. Available in 6,000, 10,000 and 15,000 lbs. test, and in corrosion resistant alloy.

GATHERING MANIFOLDS



OIL AND GAS SEPARATORS

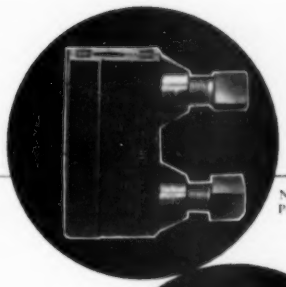
CHRISTMAS TREE FLOW MANIFOLDS



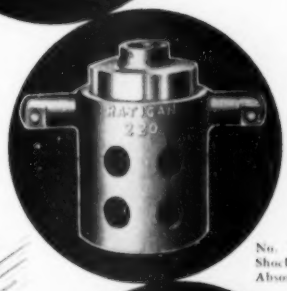
HEATERS AND TREATERS

THORNHILL-CRAVER COMPANY • P. O. BOX 1184 • HOUSTON, TEXAS

MORE profitably producing wells are RATIGAN equipped...

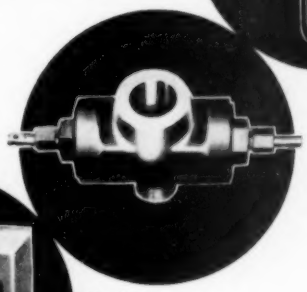


No. 204
Polished Rod Grip



No. 220
Shock
Absorber

No. 219
Wire Line Clamp



No. 212
Blowout Preventer

No. 176
Stuffing Box

No. 176-1P
Lubricating Cap

Regardless of well depth, Ratigan "Sure-Grip" Oil Well Pumping Equipment gives maximum efficiency at far less operating and maintenance cost...assures greatest return per dollar investment. Ratigan products have been proved by many years of top performance under all operating conditions, and in all major producing areas more and more operators are insisting on Ratigan Equipment. Why not specify Ratigan Pumping Equipment on your well?...sold by leading supply stores everywhere.

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OIL-LESS BEAM HANGERS AND ROD HANGERS
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ADJUSTABLE SUCKER ROD LINE WEIGHTS
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1213 Santa Fe Avenue, Los Angeles 21, California

Export: National Supply Company, Inc., Export Division,
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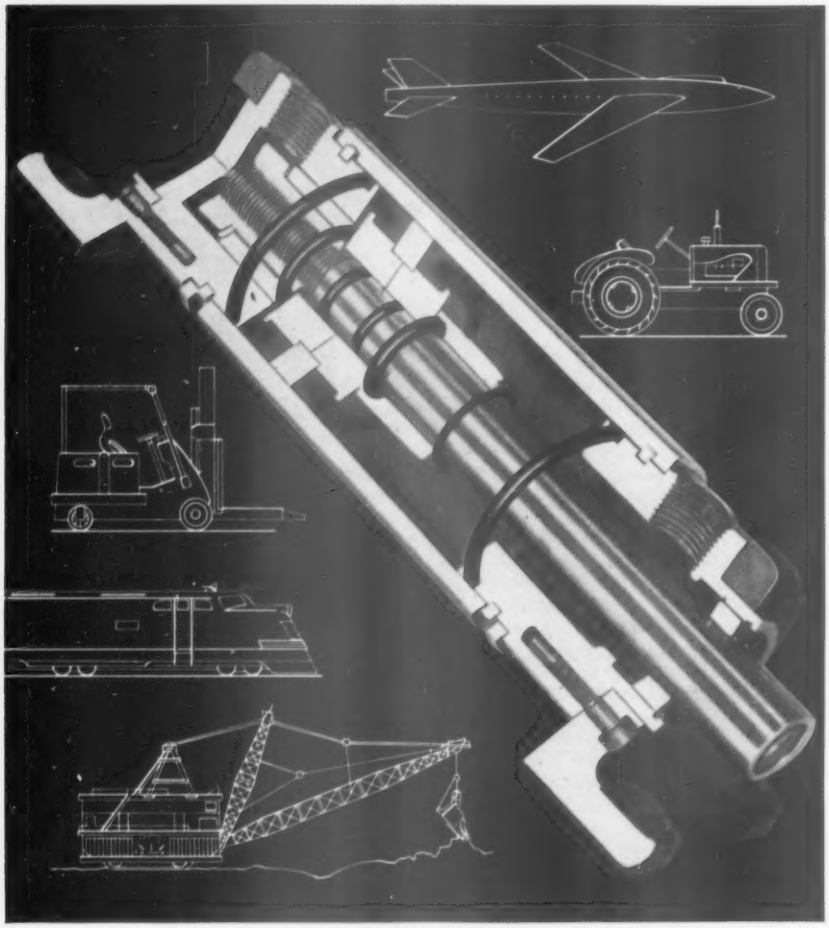
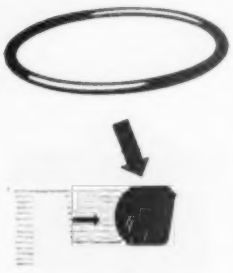
Ratigan Pumping Equipment Is RIGHT for Your Producing Well



Cutaway view of an Ortman Miller Machine Co. Standard Hydraulic Cylinder showing PARKER O-rings.

Specify PARKER O-rings for economical, leakproof seals

THIS IS IT



Cross section drawing of O-ring in groove, sealing under pressure.

For sealing in a hydraulic cylinder . . . or for whatever service you need them, you can get PARKER O-rings, molded of expertly formulated synthetic rubber compounds, that will provide long, trouble-free sealing life. That means they are economical to use. They're economical, too, because they require no complicated design . . . just a simple groove, usually saving space and weight.

PARKER makes *all* standard O-rings for fuel, hydraulic and engine oil services as well as special-service O-rings. Ask your PARKER O-ring Distributor for Catalog 5100, or write The PARKER Appliance Co., 17325 Euclid Ave., Cleveland 12, O.

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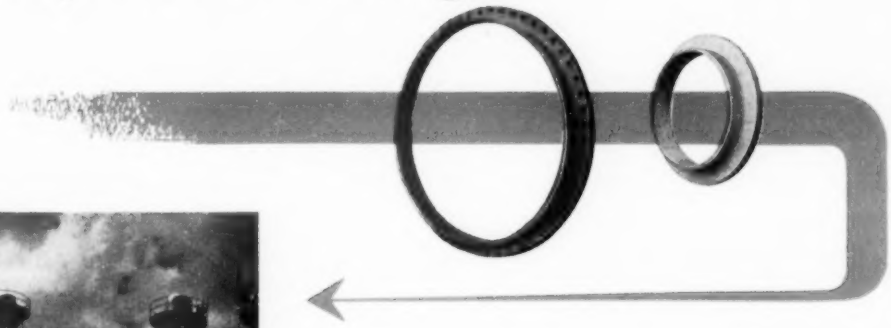
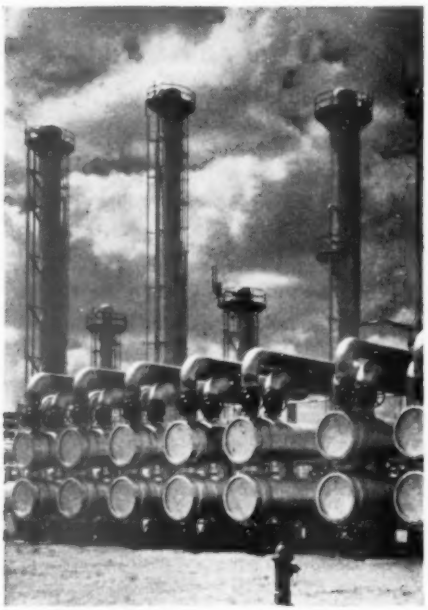
Railway & Power Engineering Corp., Ltd.

for better connections—

Specify

Railway Steel Flanges





The flanges on your heat exchangers, pressure vessels and piping are among the most important safeguards your products have. Using top quality Railway Steel flanges assures you top performance in every application.

Alloy and carbon Railway Steel flanges are made from start to finish by our metallurgists and craftsmen. The steel is produced in our own furnaces. Complete and rigid control is maintained over every stage of fabrication—forging, rolling, heat treating, machining. Railway Steel flanges are made in a wide range of sizes and sections from 18 in. ID to 150 in. OD. . . all standard types, plus special types including flanges to meet TEMA specifications.

See our sales representative in Chicago, Cleveland, Houston, New York, Richmond, San Francisco, St. Louis, St. Paul or Tulsa* for full information about Railway Steel flanges.

**Ardun Supply Company*

Railway also fabricates weldless rings for use as brake rims, gear blanks and circular forgings of many types. All are forged of our own steels assuring top performance, complete dependability, long life.

Railway Steel Flanges

RAILWAY STEEL-SPRING DIVISION

AMERICAN LOCOMOTIVE COMPANY

4 Powerful Reasons why costs go down with CHEVROLET ADVANCE-DESIGN TRUCKS on the job

EXTRA POWER WITH ECONOMY! More hauling power, greater economy! That's the result of new 7.1 to 1 compression ratio of improved Loadmaster engine on 5000 and 6000 Series heavy-duty and forward control models—optional on 4000 Series heavy-duty trucks. Thriftmaster engine in light- and medium-duty models provides traditional Chevrolet economy.

ENGINEERED FOR THE JOB! With Chevrolet, you buy a truck that is exactly right for the job. Not too big. Not too small. You get a truck engineered from the ground up with your job in mind—with the right tires, springs, axle, clutch and engine. You get a truck that will stick on the job day after day, and do your work at lowest cost.

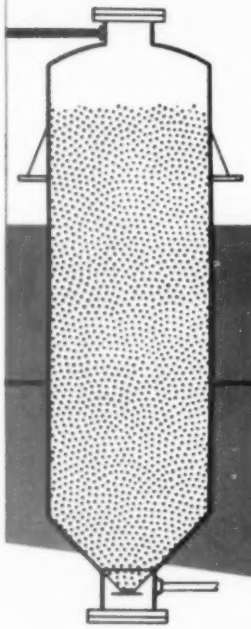
BUILT TO LAST! The extra-sturdy construction of Chevrolet advance-design trucks means longer life, even lower costs. Now, Chevrolet trucks are brawnier than before—with heavier, more rigid frames, with greater ruggedness and stamina built right in. These are the toughest and the sturdiest Chevrolets ever.

THE LINE LISTS FOR LESS, TOO! With all the solid superiorities that Chevrolet offers—with all their special features and advantages—this great line of haulers lists for less than any other trucks of comparable size and specifications. See your Chevrolet dealer. Chevrolet Division of General Motors, Detroit 2, Michigan.

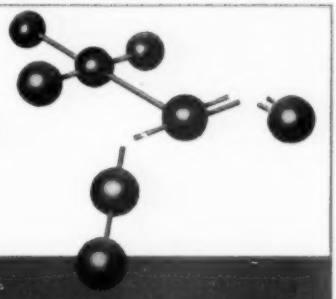
CHEVROLET ADVANCE-DESIGN TRUCK FEATURES

TWO GREAT VALVE-IN-HEAD ENGINES—the Loadmaster or the Thriftmaster—to give you greater power per gallon, lower cost per load. **POWER-JET CARBURETOR**—for smooth, quick acceleration response. **DIAPHRAGM SPRING CLUTCH**—for easy-action engagement. **SYNCHRO-MESH TRANSMISSION**—for fast, smooth shifting. **HYPOID REAR AXLE**—for dependability and long life. **TORQUE-ACTION BRAKES**—on light-duty and medium-duty models and on front of heavy-duty models. **TWIN-ACTION REAR BRAKES**—on heavy-duty models. **DUAL-SHOE PARKING BRAKE**—for greater holding ability on heavy-duty models. **CAB SEAT**—with double deck springs for complete riding comfort. **VENTIPANES**—for improved cab ventilation. **WIDE-BASE WHEELS**—for increased tire mileage. **BALL-GEAR STEERING**—for easier handling. **UNIT-DESIGNED BODIES**—for greater load protection. **ADVANCE-DESIGN STYLING**—for increased comfort and modern appearance.

CHEVROLET
first in demand
in value
in sales



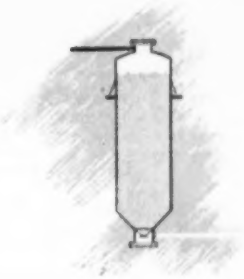
...ready to tackle
any sorptive-mineral job
that comes along...



ATTAPULGUS Fullers Earth
POROCEL Activated Bauxites

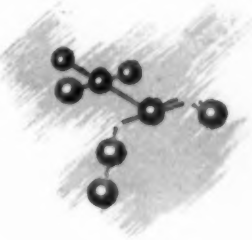
ADSORBENTS

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils; chemicals and petrochemicals.



CATALYSTS, CATALYST CARRIERS

Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.



DESICCANTS

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

SPECIAL GRADES

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs are ready to assist in research, development, design and operating problems. Your inquiries are invited.

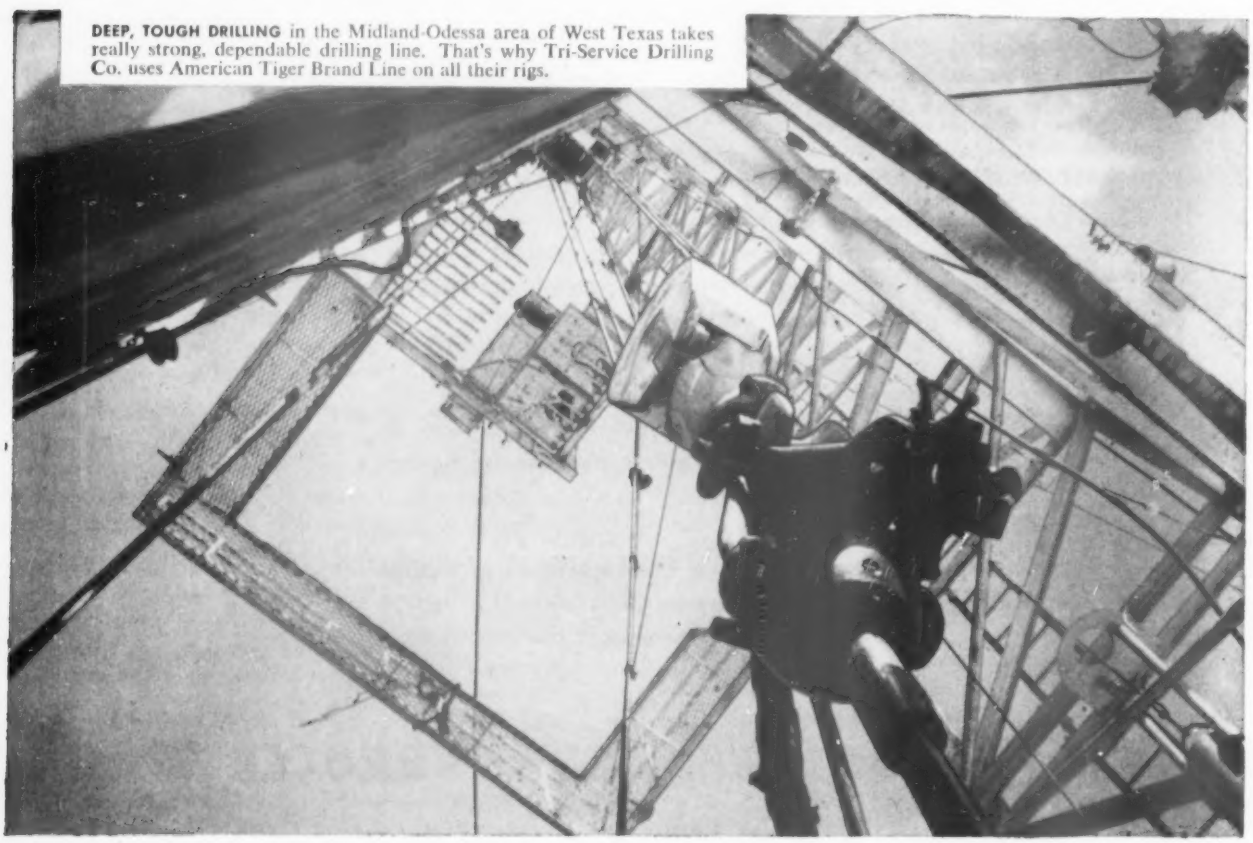
ATTAPULGUS MINERALS & CHEMICALS CORPORATION · **POROCEL** CORPORATION

Dept. V, 210 West Washington Square, Philadelphia 5, Pa.

"We use because they

PRENTISS HIGHTOWER, Driller on Rig. No. 5, says, "We've drilled 49,700 feet of well with this one length of American Line, and it's still in good shape. We like American Lines because we can depend on them and they give us long service."

DEEP, TOUGH DRILLING in the Midland-Odessa area of West Texas takes really strong, dependable drilling line. That's why Tri-Service Drilling Co. uses American Tiger Brand Line on all their rigs.



American Wire Lines give us longer service and less trouble"

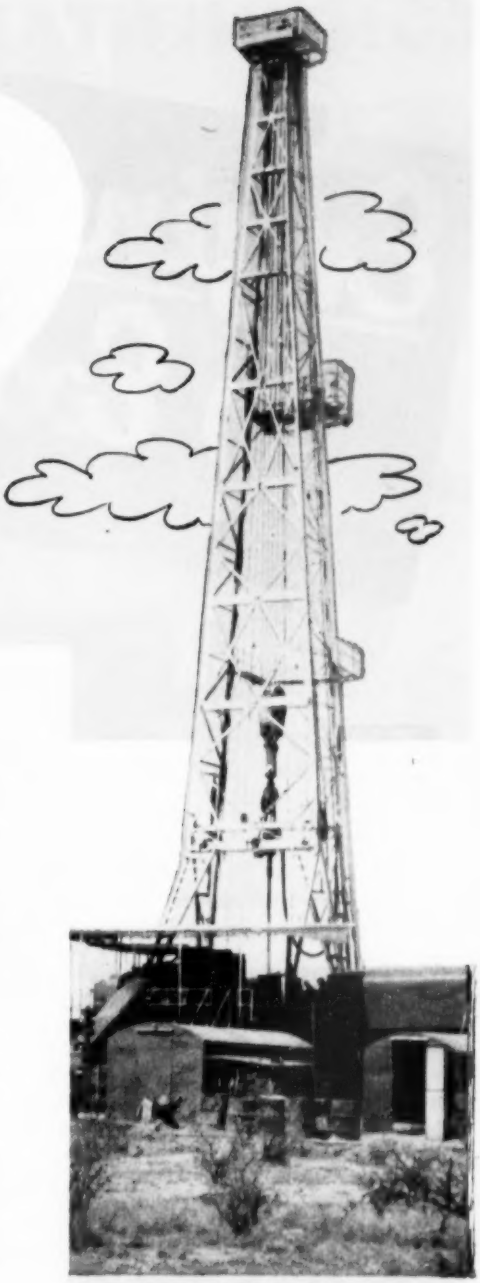
says Tri-Service Drilling Co., Midland, Texas

MR. M. W. BRANNON, president of Tri-Service Drilling Co., tells us: "We experimented with various brands of line, and found that American Tiger Brand Lines give us the best service. That's why we use American Lines on all of our wells . . . when we find something good, we stick with it!"

Tri-Service Drilling Co. operates five rotary rigs and one cable tool rig in the Midland-Odessa area of West Texas. The rotary rigs are equipped with 1⅛" and 1¼" Tiger Brand Rotary Lines with Independent Wire Rope Cores. The cable tool rig has Tiger Brand Cable Tool Line.

Rig No. 5, an "OILWELL" No. 76, has drilled 7 wells totaling 49,700 feet of extremely tough drilling with just one length of American Tiger Brand 1¼" Rotary Drilling Line. This line is still in use and giving good service.

American Wire Lines come in many types to suit every drilling need. In addition to Rotary and Cable Tool Drilling Lines, there are American Sand Lines, Torpedo Lines, Winch Lines, Hoisting Ropes, and Steel Guy Strand. So next time you buy line, call the American Wire Rope Distributor in your area—he has got *just the line you need.*



TRI-SERVICE DRILLING CO.'S Rig No. 5 was down to 6285 feet on this well in 20 days.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL CORPORATION
GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

U·S·S AMERICAN TIGER BRAND WIRE ROPE

Excellay Preformed

UNITED STATES STEEL

CONTINENTAL RED SEAL POWER

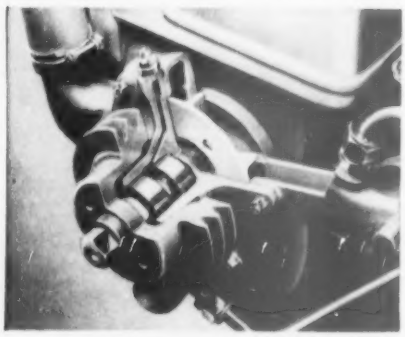
IS Engineered to Excel

IN THE OIL FIELD

SEE OUR CATALOG IN COMPOSITE CATALOG

LEAKPROOF WATER PUMP

Potentially disastrous loss of coolant is positively prevented by Continental's leakproof water pump, in which spring-loaded carbon disc within the impeller housing maintains a seal against corrosion-resistant stainless steel seat. Note too the widely-spaced bearings, and provision for keeping space between them packed with lubricant. One of many outstanding features of Continental Red Seal engineering.

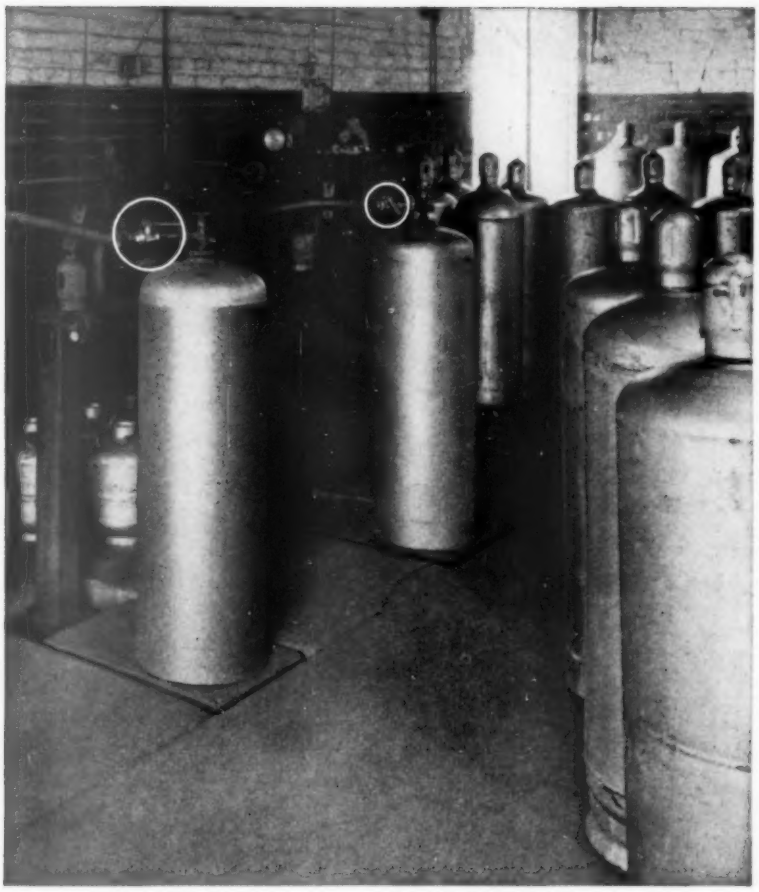


Continental Red Seal oil field power is engineered and built with the rigorous requirements of oil field use in mind. A product of more than 50 years' specialized experience, it embodies an array of quality features—many of them exclusive—making for economy, dependability and long troublefree life. What is equally important, it has the backing of genuine parts and factory-authorized service from coast to coast, wherever there's Red Seal power in use.

6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS
3817 S. SANTA FE AVE., LOS ANGELES 58, CALIFORNIA

Continental Motors Corporation

MUSKEGON, MICHIGAN



Big propane plant reports:

"Increased production and no maintenance"

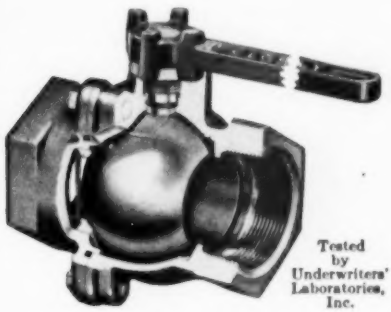
with these amazing new ball valves

One of many enthusiastic users of Rockwood Ball Valves, this large propane plant ships up to 400 tanks of bottled gas daily to householders. Valves are operated every two minutes during the day. The plant supervisor states their extra fast opening and closing, full *round* flow and tight seal makes them real production boosters and cost cutters . . . *and they need absolutely no maintenance!*

ROCKWOOD *FULL-FLOW* BALL VALVES

THE FLOW IS AS ROUND AS THE PIPE ITSELF

Safest, too! Because of their leakproof construction, Rockwood Ball Valves were selected as safest for handling inflammable gases on the Texas Transport Company's fleet of propane-butane trucks.



Tested by Underwriters' Laboratories, Inc.

4 BIG FEATURES FOR TOP PERFORMANCE

Full Round Flow . . . no change in shape or volume of the fluid stream . . . no turbulence . . . minimum friction loss.

Quick Opening And Closing . . . needs only a quarter turn, even under full pressure.

Resists Wear Longer . . . scratching, pitting and abrasion have little effect on the chrome-plated, floating bronze ball.

Stays Leakproof . . . in closed position, pressure of fluid automatically positions ball against synthetic rubber seat to form a tight seal.

Get the whole story of how this outstanding Rockwood development gives you more of what you want in valve performance. Mail the coupon today.

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Send me illustrated folder V-4 on Rockwood Full-Flow Ball Valves.

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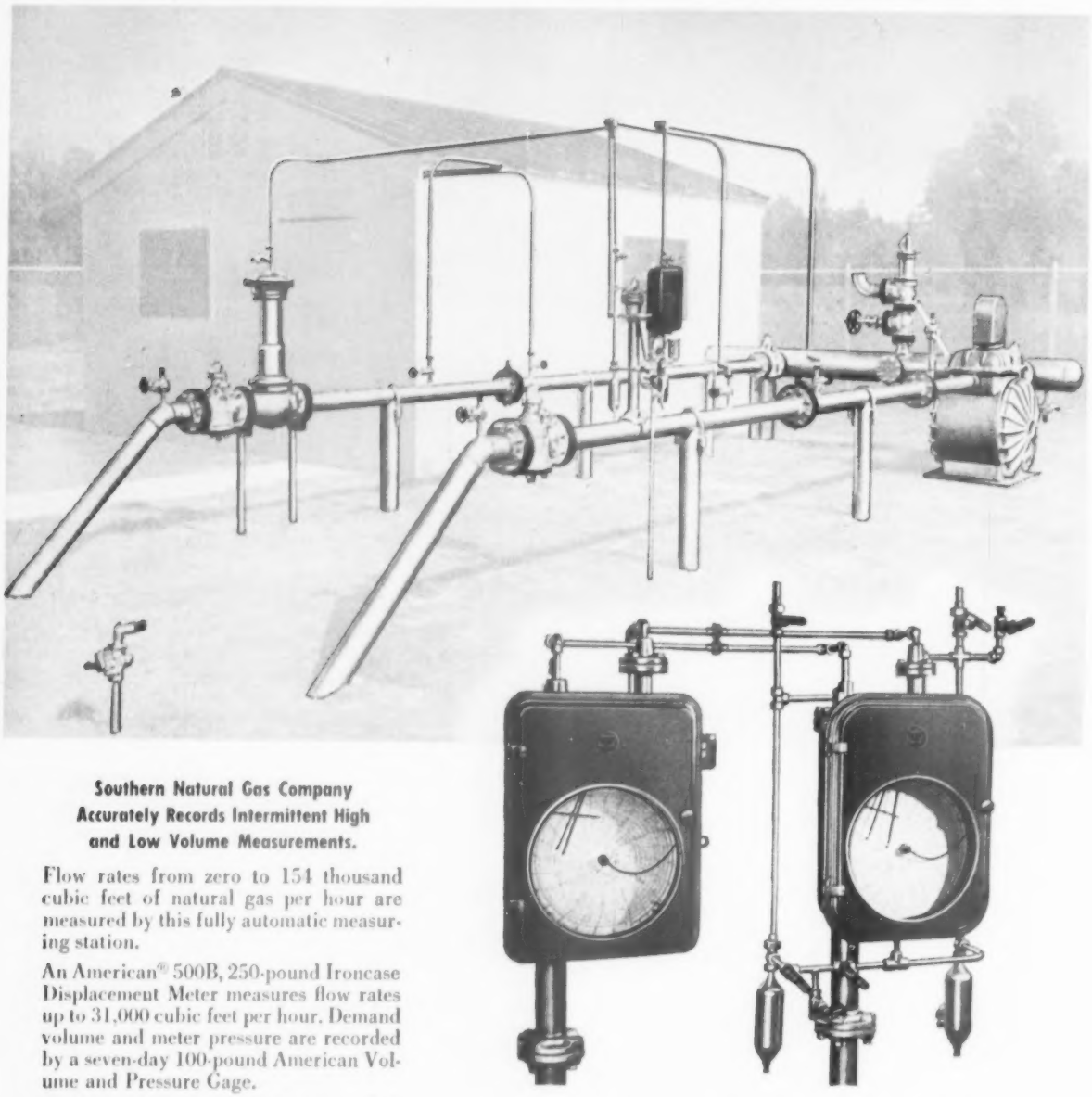
PRECISION GAS MEASUREMENT AT HIGH OR LOW FLOW RATES



Southern Natural Gas Company Accurately Records Intermittent High and Low Volume Measurements.

Flow rates from zero to 154 thousand cubic feet of natural gas per hour are measured by this fully automatic measuring station.

An American® 500B, 250-pound Ironcase Displacement Meter measures flow rates up to 31,000 cubic feet per hour. Demand volume and meter pressure are recorded by a seven-day 100-pound American Volume and Pressure Gage.

A 100-inch Series A-88 American Differential Valve actuates a 4-inch Type CBVA Reliance Control Valve transferring approximately 80 percent of the flow to the orifice meter run when flow rates exceed the capacity of the Ironcase Meter.

This Duplex installation consisting of 20-inch — 100-inch Series A-88 American Westcott Orifice Meters records 80 percent of the flow at rates from 31 thousand to 154 thousand cubic feet at normal operating pressures of 50 pounds gauge pressure in the orifice meter run when used in the above combination with the 500B Meter.

AMERICAN® METER COMPANY
INCORPORATED ESTABLISHED 1836

AMERICAN METER CO

GENERAL SALES OFFICE: 1513 Race Street, Philadelphia
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Boston • Chicago • Dallas • Denver • Erie • Houston
Kansas City • Los Angeles • Minneapolis • New York
Odessa • Omaha • Pittsburgh • Tulsa • San Francisco
IN CANADA: Canadian Meter Company, Limited
Hamilton, Ontario • Edmonton, Alberta

Fantastic

is not the word

A score of years ago scoffers called it fantastic when drillers talked in terms of pay below 10,000 feet.

A decade ago other people used the same word—fantastic—to deride penetrations below 20,000 feet.

Predictions of new productive strata in the hearts of old fields drew the same scornful comment.

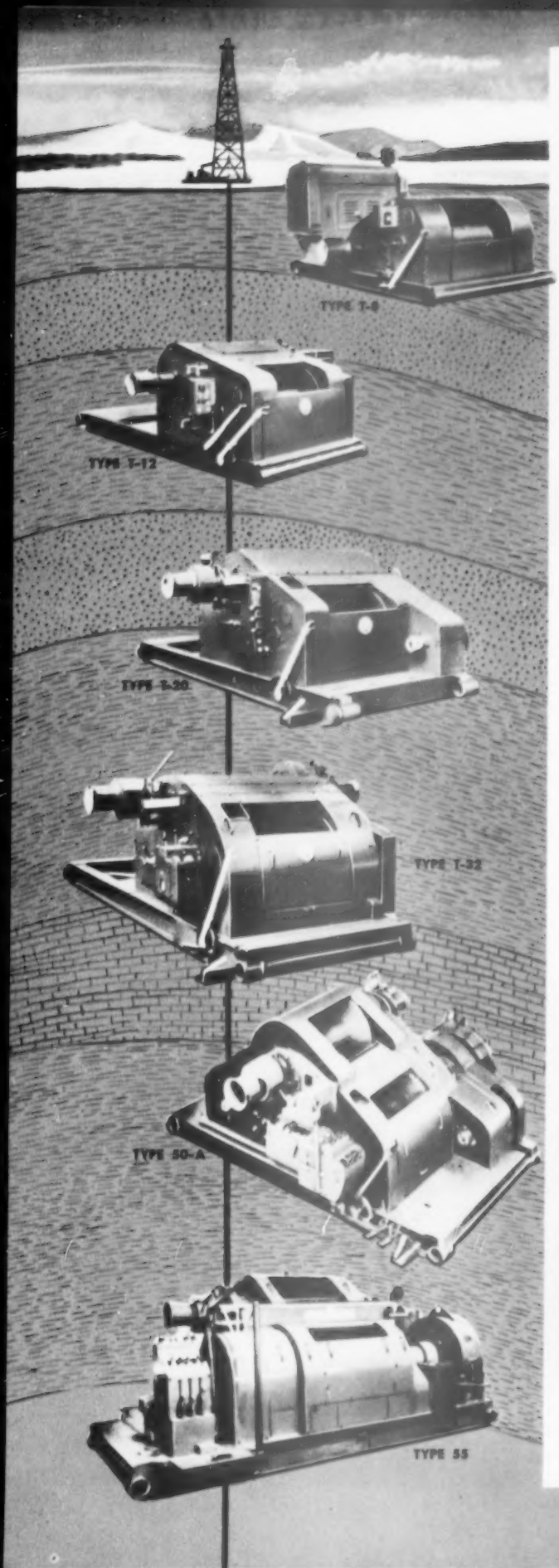
In the minds of many, then, it is fantastic to talk of rigs on the polar ice caps, of drilling in mid-ocean fields, of recovery beyond today's proven depths.

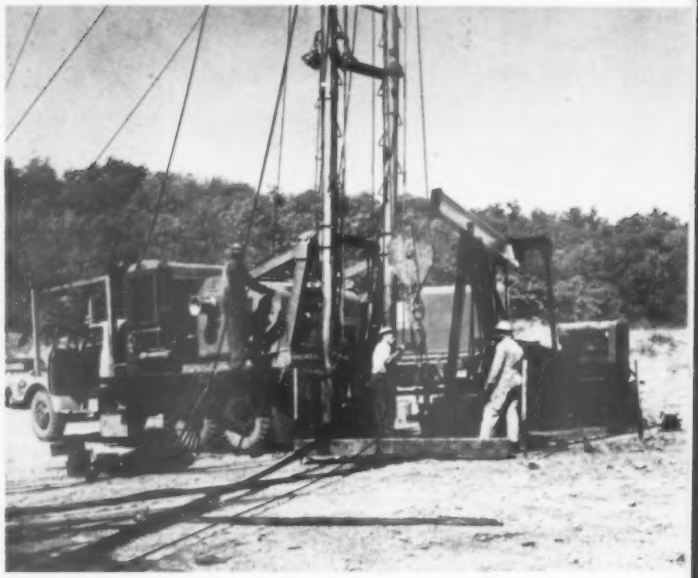
But petroleum industry decades being what they are—so fast in growth, so vast in accomplishments—an important part of the daily research and development work at National Supply is devoted to preparation for building the equipment the industry may need before tomorrow passes.

As always, the engineering and manufacturing facilities at National Supply are actively engaged in supplying the oil industry with a complete line of equipment for every drilling and production requirement. That's why it's always well to keep an eye on what's new in "National Blue."

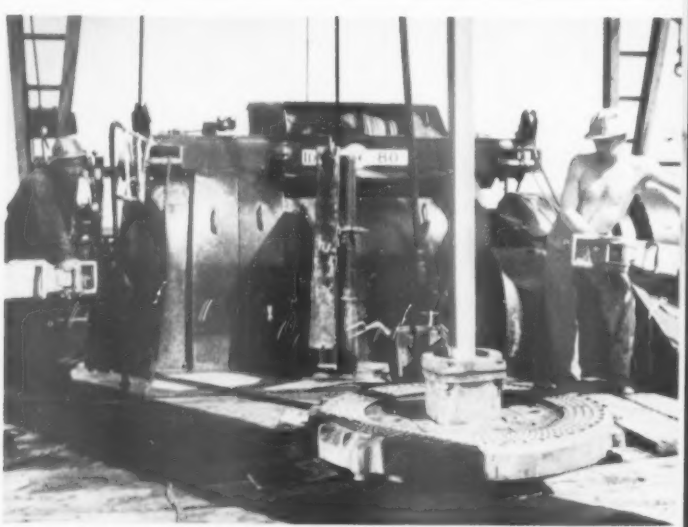
THE NATIONAL SUPPLY COMPANY

Pittsburgh 30, Pennsylvania





IDEAL RIGS



NATIONAL OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE • SUPERIOR & ATLAS ENGINES

Built for drilling
at any depth

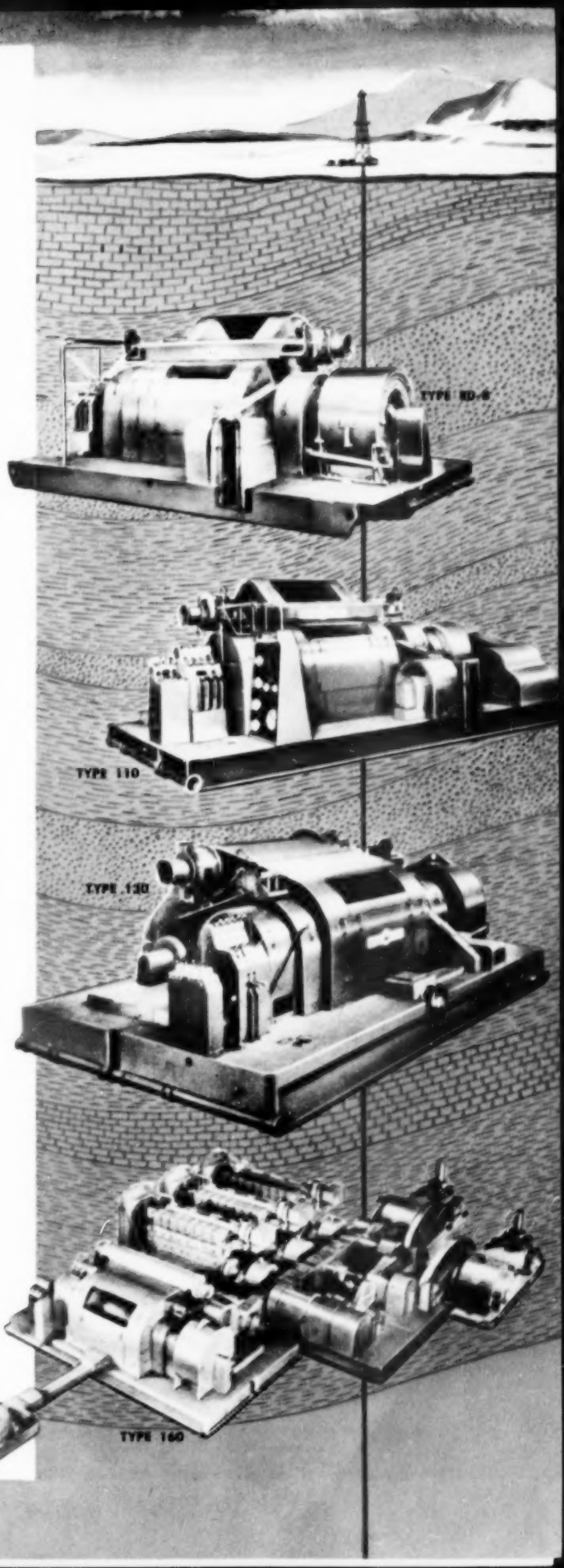
To keep its equipment development program closely tied in with the day-to-day requirements of the drilling industry, National's field engineering staff is constantly at work in the major oilfields. Information collected by these equipment specialists makes it possible for National Supply to satisfy every operator's machinery needs for drilling at any depth.

When the Type 160 Consolidated Rig was first introduced, few people expected to use so much drilling capacity. But the ever-increasing depth range has made the "Ideal" Type 160 an increasingly important factor in the industry.

At the other end of the scale, four sizes of "Ideal" hoists and rigs provide efficient, easily portable equipment for servicing, workover, and shallow-well drilling. Many units of this type are truck or trailer mounted to facilitate their mobility, and reduce rigging-up time.

Between these largest and smallest units are the other members of the complete family of "Ideal" Drilling Rigs, with Superior Drilling Engines and Ideal Drive Groups. As a result, operators can purchase *from a single reliable source* machinery which is designed and built to work together for drilling at any depth.

New bulletins and brochures are now available covering single units for specific requirements, as well as comprehensive bulletins on portable rigs, control and drive assemblies, and related "Ideal" equipment. Why not write for this latest information and bring your National literature file up to date?



NATIONAL BLUE PRODUCTS

THE NATIONAL SUPPLY COMPANY

PITTSBURGH 30, PENNSYLVANIA

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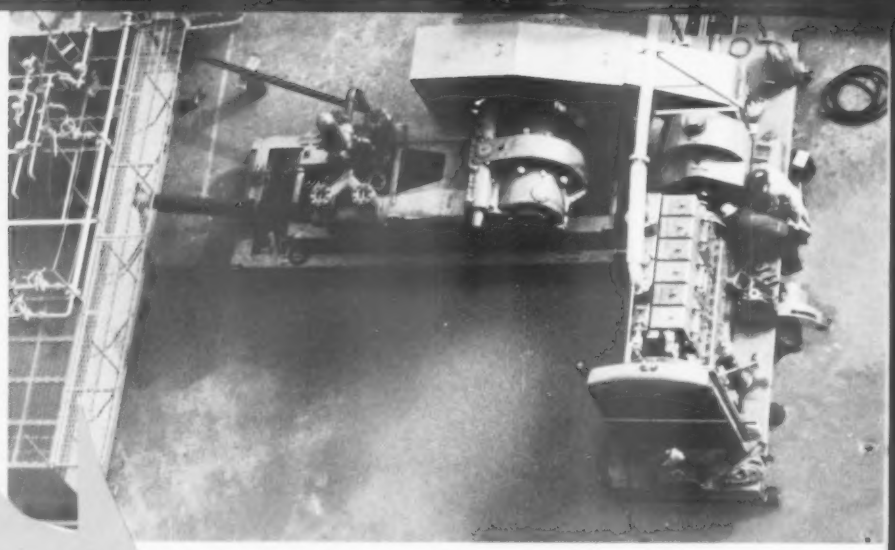
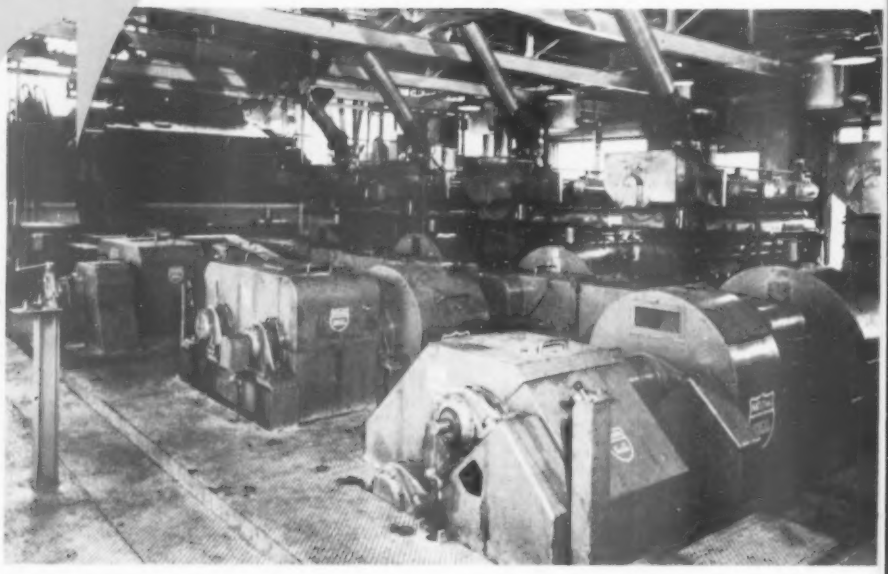
CANADA: The National Supply Company, Ltd., 200 F. W. Clark Building, 709 Eighth Avenue, West, Calgary, Alberta

EXPORT: 600 Fifth Avenue, New York 20, N.Y., U.S.A., River Plate House, 12 South Place, London, E.C. 2

IDEAL DRIVE GROUPS

Versatile combinations for powering consolidated rigs and slush pumps





Through long association with the drilling industry National engineers have had every opportunity to study power requirements and power transmission equipment. The complete line of "Ideal" Drive Groups and "Ideal" Independent Pump Drives reflects National's extensive experience, not only with drilling equipment but with diesel and gas engines.

Consequently, when you purchase "Ideal" Rigs and Slush Pumps, powered by "Superior" Engines, and equipped with "Ideal" Drive Groups you have the most flexible equipment combinations, and the optimum power application for drilling under all conditions.

Some of the features, described in detail in bulletins now ready for distribution, and which emphasize the versatility of "Ideal" Drive Groups would include:

SECTIONALIZED CONSTRUCTION, each section a completely and accurately aligned portable unit

WIDE POWER RANGE, with engine and drive combinations from 80 to 2010 horsepower

SLUSH PUMP DRIVES, independent or integral types, for every fluid requirement

THREE TYPES OF TRANSMISSIONS, mechanical, "Ideal" Gyrol, or "Ideal" Torque Converter

THE NATIONAL SUPPLY COMPANY

Pittsburgh 30, Pennsylvania

DIVISION OFFICES: Denver • Ft. Worth • Houston • Pittsburgh • Tulsa • Torrance

CANADA: The National Supply Company, Ltd., 200 F. W. Clark Building, 709 Eighth Avenue, West, Calgary, Alberta

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NATIONAL BLUE PRODUCTS

NATIONAL OIL FIELD MACHINERY AND EQUIPMENT • SPANG STEEL PIPE • SUPERIOR & ATLAS ENGINES

Facts prove the economy of RUST-OLEUM®

Apply Directly Over Sound Rusted Surfaces

Just scrape and wirebrush to remove rust scale and loose particles — then brush Rust-Oleum 769 Damp-Proof Red Primer *directly over sound rusted surface.*

Lasts Longer Applied Directly Over Rust

Sandblasting, chemical pre-cleaning and other costly preparation methods are *not* usually required. Rust-Oleum penetrates the rust to bare metal, incorporating the rust particles into the coating.

Many Colors, Including Aluminum, and White

Rust-Oleum finish coatings incorporate the same basic rust-inhibiting vehicle as Rust-Oleum 769 Damp-Proof Red Primer. They provide *double protection* and enable you to *beautify as you protect.*

Practical Answer to Your Rust-Producing Conditions

Rust-Oleum resists rain, snow, heat, fumes, sun, salt water, and chemicals. So easy to use by brush, dip, or spray that one man often does the work of two.

Proved Throughout Industry for Over 25 Years

Indoors and out, Rust-Oleum has proved its capacity to stop rust! Rust-Oleum can do the same for your tanks, metal sash, stacks, girders, roofs, buildings, machinery, pipes, etc.

An Exclusive Formula

Rust-Oleum is *distinctive* as your fingerprint. It incorporates a specially-processed fish oil vehicle that *dries*, is *odor-free*, and is formulated in *many colors*. Specify Rust-Oleum — accept no substitutes.

There Is Only One Rust-Oleum

RUST-OLEUM STOPS RUST!

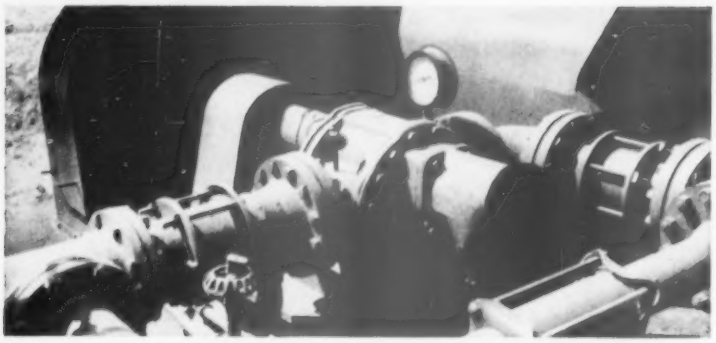
ATTACH TO YOUR LETTERHEAD — MAIL TODAY!

RUST-OLEUM CORPORATION
2542 Oakton Street, Evanston, Illinois

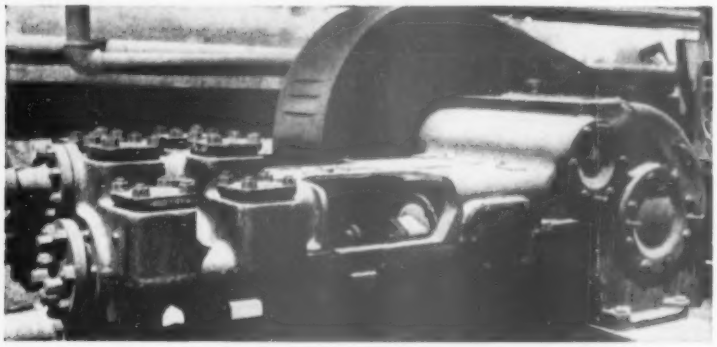
- ☐ Have a Qualified Representative Call
- ☐ Free Survey
- ☐ Complete Literature
- ☐ Nearest Rust-Oleum Industrial Distributor

Why 3 different pumps for 3 similar Jobs?

WORTHINGTON STEAM PUMP at a West Coast petroleum company delivers 10° API crude oil from a lease tank to several treating tanks. Available steam drives this heavy-duty pump with minimum power costs. A single boiler is used for heating the oil before it is pumped, as well as supplying steam to drive the pump.



WORTHINGTON ROTARY PUMP handles approximately 300 GPM of 32° API crude oil at the Tidewater Associated Oil Company in Ventura, California. At pressures ranging from 250 to 325 psi, the crude oil is pumped from a dehydration plant to a central group of tanks. Throughout the country, Worthington rotary pumps have proven themselves in refinery service, handling anything from asphalt to gasoline.



WORTHINGTON POWER PUMPS at the Continental Consolidated Corp., in Long Beach, California, move 14-16° API crude oil from a lease tank through a pipeline to nearby refineries. The pumps have been in service for eight years, handling crude oil against pressures ranging from 200 to 600 psi. This heavy-duty pump is ideal for all large capacity, high-pressure service.

Three different types of Worthington pumps were installed for the same kind of service at these oil companies. Why? Because the combination of pressure requirements and the type of power available differed in each case. Worthington, the oldest and largest pump manufacturer in the world, can give you *exactly* the pump for your needs. Get in touch with your nearest Worthington district office for more details. Or write directly to Worthington Corporation, Reciprocating Pump Division, Harrison, New Jersey.

P.3.1

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

Reciprocating and Rotary Pumps

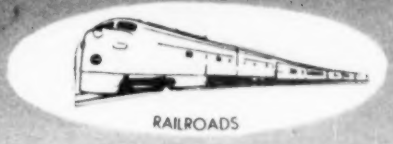
AEROQUIP SELF-SEALING COUPLINGS

AND FLEXIBLE HOSE LINES

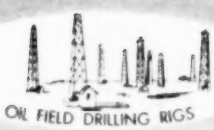
BUSES AND TRUCKS

Speed Maintenance

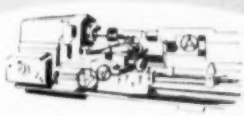
WHEREVER FLUID-CARRYING LINES MUST BE DISCONNECTED AND RECONNECTED



RAILROADS

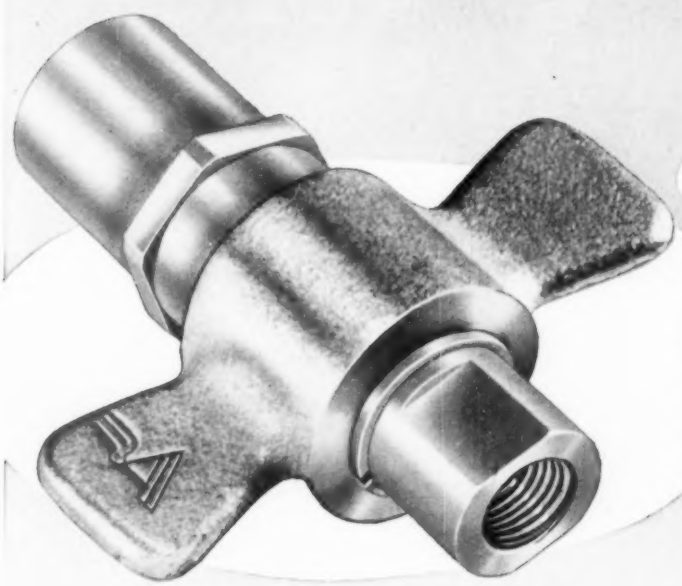


OIL FIELD DRILLING RIGS



MACHINE TOOLS

MATERIALS HANDLING TRUCKS



Speed **maintenance,** ***speed*** **repair operations and** ***speed*** **interchanging of accessories joined by fluid-carrying lines with Aeroquip Self-Sealing Couplings. Lines may be separated in a few seconds without loss of fluid. No air enters the system upon reconnection. There is no need to drain or prime the fluid system. One Self-Sealing Coupling takes the place of two shut-off valves.**

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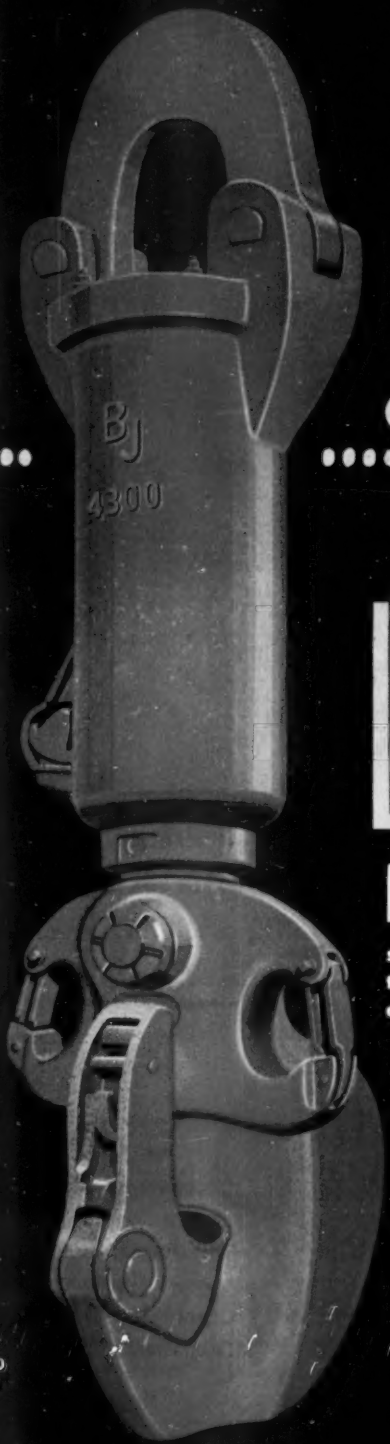

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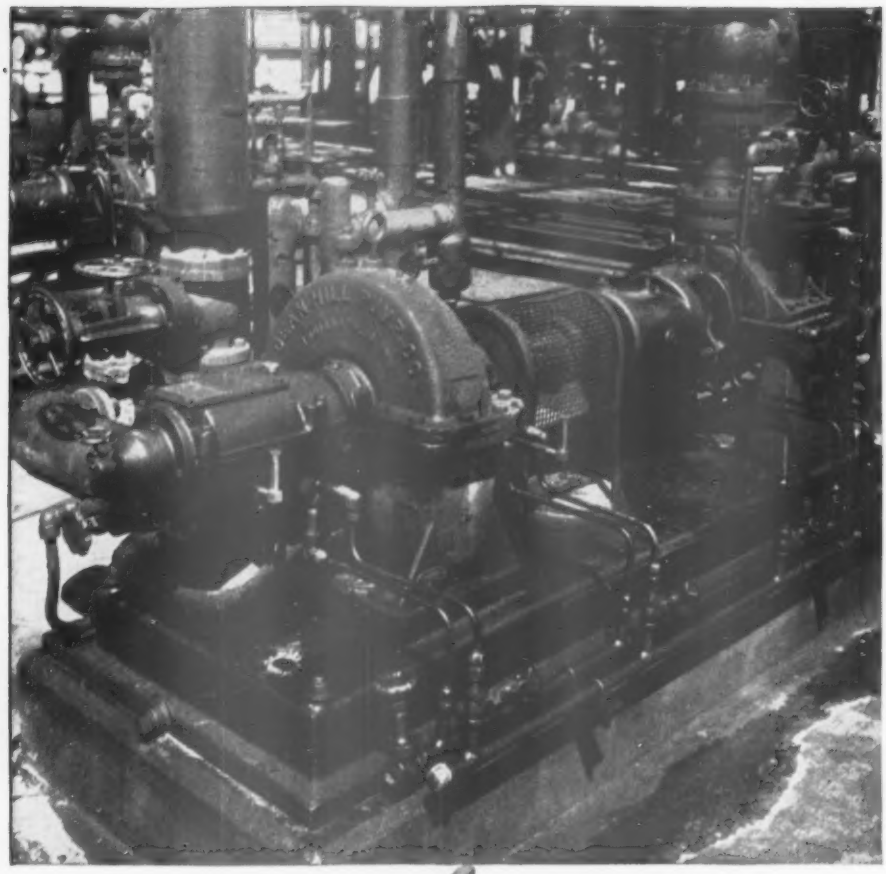

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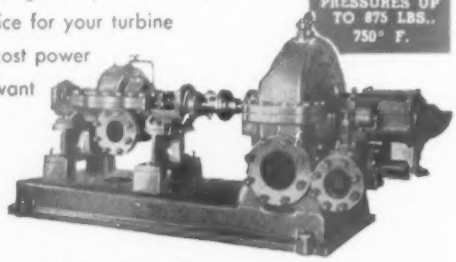

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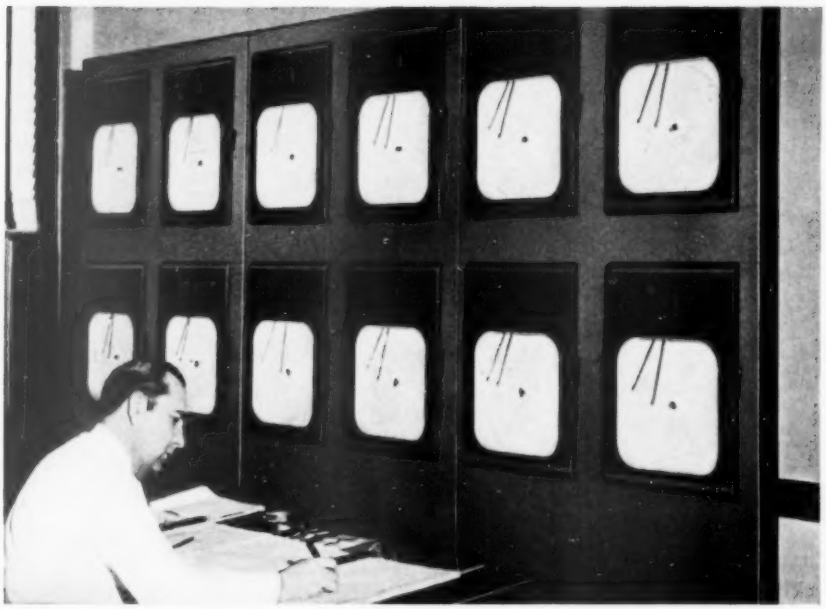

Metameter Telemeter Receivers in dispatching office, Midland Building, Kansas City, Mo., record suction and discharge pressures and static and differential pressures coming in by microwave from distances nearly 400 miles away. They give dispatcher a continuous visual picture of pressure conditions along Panhandle Eastern Pipe Line system.

MICROWAVE METAMETER TELEMETERING on the PANHANDLE EASTERN pipe line

Gives dispatcher the information he needs for better pressure regulation—enables him to foresee abnormal conditions and prevent interruptions—promotes greater operating efficiency

Bristol Metameter* Telemeters, using microwave transmission over some 400 miles of this company's pipe line system, bring readings of compressor suction and discharge pressures and static and differential pressures to the Kansas City dispatching office where they are recorded by 12 Metameter receivers within sight of the dispatcher.

Continuous information about suction and discharge pressure at Houstonia, Centralia, Pleasant Hill, Glenarm, and Tuscola, Ill., compressor stations and static and differential pressures at Tuscola enables the dispatcher to obtain better pressure regulation and to foresee abnormal situations and make corrections before they cause interruptions. Continuous observation of pressures along the pipe line system promotes economies and a feeling of security.

Metameter Telemeters are widely used with microwave radio communication systems. Provisions for future use or additional Metameter Telemeters are made on many microwave systems at the time of installation.

Other uses by pipe line companies include remote setting of regulators and flow controllers; remote readings of line pressure; sounding low and high pressure and flow limits alarms; totalizing flow through several lines.

For further information on the use of Bristol Metameters by pipe line and gas companies, from coast to coast, request Bulletin M1700, THE BRISTOL COMPANY, 120 Bristol Road, Waterbury 20, Conn.

*Reg. U. S. Pat. Off.

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Every angle completely covered . . . but one! When fire strikes during the night your skilled labor may go in the morning. The fully experienced Joes, Bills and Toms can't stand the financial strain of waiting . . . their time cards can become travel tickets to new jobs, while you're struggling to replace the ravages of fire.

The threat of losing your skilled labor due to an unexpected fire tragedy can be fully eliminated. With C-O-TWO Smoke or Heat Fire Detecting Systems plus C-O-TWO High Pressure or Low Pressure Carbon Dioxide Type Fire Extinguishing Systems your plant can have fast, positive, round-the-clock fire watchman service simultaneously at each fire hazard point.

At locations where a deep-seated, smoldering internal fire as well as a fast burning external fire might occur, the smoke detector of a C-O-TWO Smoke Fire Detecting System, based on an exclusive operating principle, automatically detects the first trace of smoke, smoldering or fire.

For locations where excessive heat or combustion might cause a flash fire, the heat detectors of a C-O-TWO Heat Fire Detecting System automatically sound a warning at the first flash of fire.

Then clean, dry, non-conducting, non-damaging carbon dioxide is instantly released from either a C-O-TWO High Pressure or Low Pressure Carbon Dioxide Type Fire Extinguishing System into the threatened area. The fire is out in seconds with little if any interruption to operations and the carbon dioxide disappears without a trace . . . one of the safest fire extinguishing agents known . . . harmless to equipment, materials and finishes.

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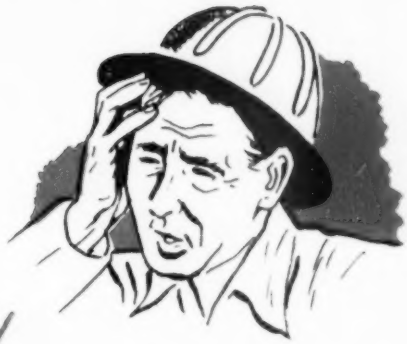
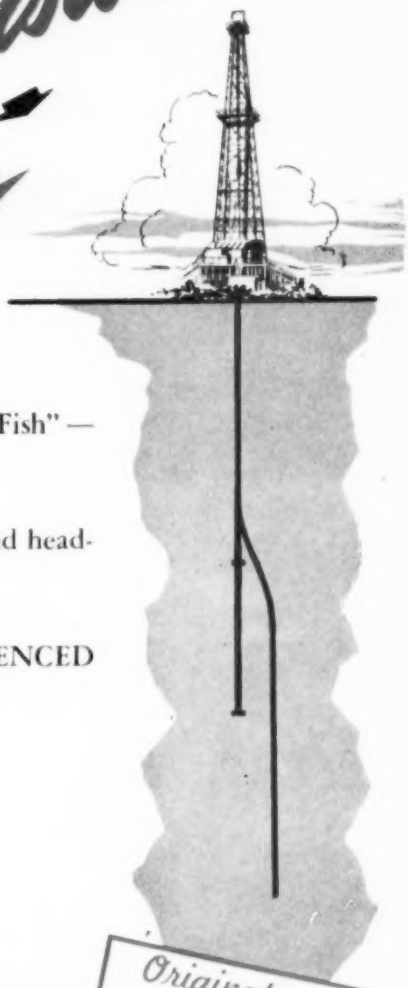
for every oil industry need

Can't Fish It?



Eastman Has the Answer . . .



REMEMBER — When you can't recover your "Fish" — CALL EASTMAN!

Sidetracking is our business. We will save you time and headaches if you will let us solve your problem.

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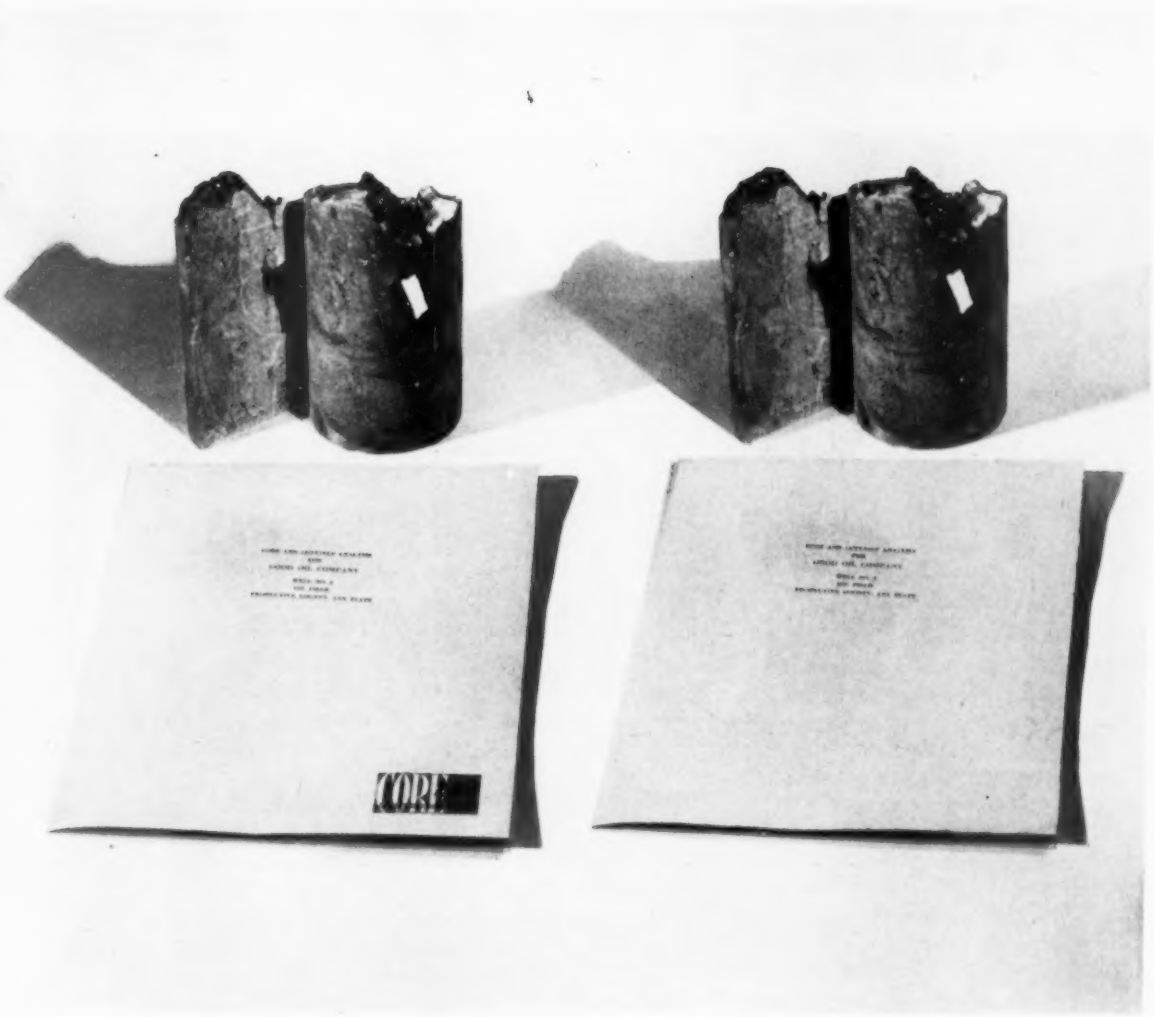
ATLAS ROLLER CHAIN



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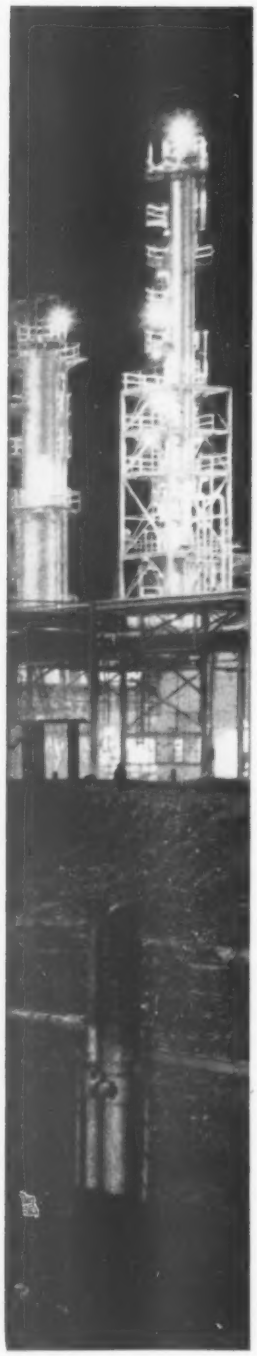
CORE LAB

PETROLEUM RESERVOIR ENGINEERING

They did what you can do to produce more

How to get high power dependability without paying for standby capacity



When Sohio modernized and expanded the Lima refinery they needed a highly dependable power system. But they didn't want to pay for emergency stand-by capacity, a common way to achieve reliability. So engineers from Sohio, Dingle-Clark Co., and Westinghouse worked out an ingenious solution based on a sound basic principle.

Ingenious Controls Instead of Transformers

The basic principle is this: that you don't need *absolutely continuous power* for high reliability, but rather *speedy restoration of service* after disturbances do occur. So instead of providing for expensive extra transformer capacity, they developed a control system that automatically and rapidly clears trouble. And a power loss up to four seconds doesn't slow down the plant.

Devastating Tornado Didn't Stop Operation

The results of this sound planning were soon evident. Nine months after installation, a devastating tornado hit Lima and knocked out one of the two power lines serving the plant. The two key motors (catalytic cracker blower drive) were thrown out of synchronization. But both were immediately restarted by the ingenious control system. Then a second fault knocked them out again and one motor restarted to keep the process going all through the disturbances.

Disturbances are Cleared Automatically

In the first nine months of operation, there were 12 disturbances which affected these key blower motors. On ten occasions, the controls automatically restarted the motors. The other two times, the motors were restarted manually. Numerous other disturbances have failed to affect plant operation in *any* way.

Call Westinghouse Early On Your Next Project

The key to continuous power is good planning. Westinghouse would like to do this kind of planning with you. Call us in *early* when *you* build, expand or modernize. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Penna.

HOW SOHIO GOT HIGH RELIABILITY AT LOW COST

To keep the costs down, they built very little spare capacity into the system. Thus if there is a momentary outage, the load must be reapplied in segments. The operation is controlled by Westinghouse high-voltage switchgear, shown at left.

The big power users are the blower motors. If power outage occurs, they're automatically taken off the line by a clever "under-frequency" relay so that the rest of the plant can start up when the fault is cleared. Then in less than one minute, one of the blower motors restarts automatically. The plant keeps operating through the disturbance.

J-94906

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What Salisbury engineers said to Mr. Spicer

When the Spicer people bought the Salisbury Axle Company in 1919, the advantages of Salisbury Axles had been widely used in automobiles and trucks since 1906.

As the Salisbury engineers pointed out to Mr. Spicer, and our young president, C. A. Dana, when the purchase was being considered, "This axle has distinctive features you can't find in any other unit. We've just had several years of front- and rear-drive war service — the kind that no axles have ever had before. Our design is *good*. That will be proved by its increasing acceptance through the years ahead."

During the past 34 years, Spicer has made millions and millions of Salisbury Axles for a wide range of civilian and military uses.

Designing, Developing, Engineering, Manufacturing and Service

Spicer

The Axles with Accent on *ACTION!*

The Spicer Salisbury Axle for passenger car and light commercial use has every qualification for extremely high efficiency in today's vehicles:

RIGIDITY—The special Spicer design and construction maintain accurate alignment of gears and bearings under all speeds and loads, assuring continued quiet operation.

LUBRICATION—Scientifically developed control of oil circulation provides a constant, correctly proportioned flow to all gears and bearings for effective lubrication and cooling.

RUGGEDNESS—Sturdily constructed to withstand the high speeds and extremes of punishment which are common in modern automotive vehicle operation.

ACCESSIBILITY—Extremely easy to get into for inspection of parts. Simple-to-remove gear cover, oil level and drain plugs reduce service time and costs.

Spicer facilities in its ten modern plants are geared to the production of Salisbury Axles for your particular needs.

SPICER MANUFACTURING DIVISION
of Dana Corporation
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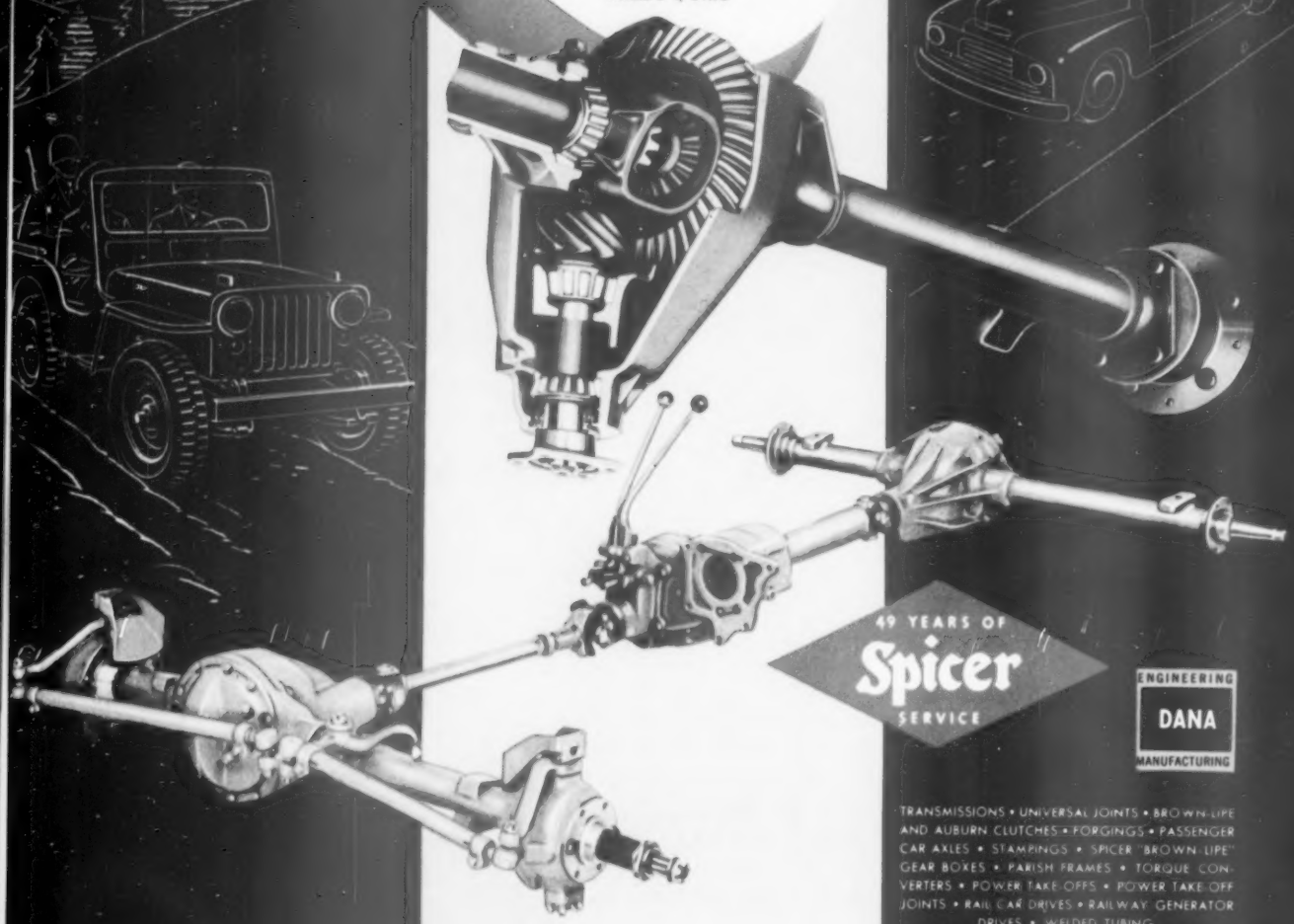

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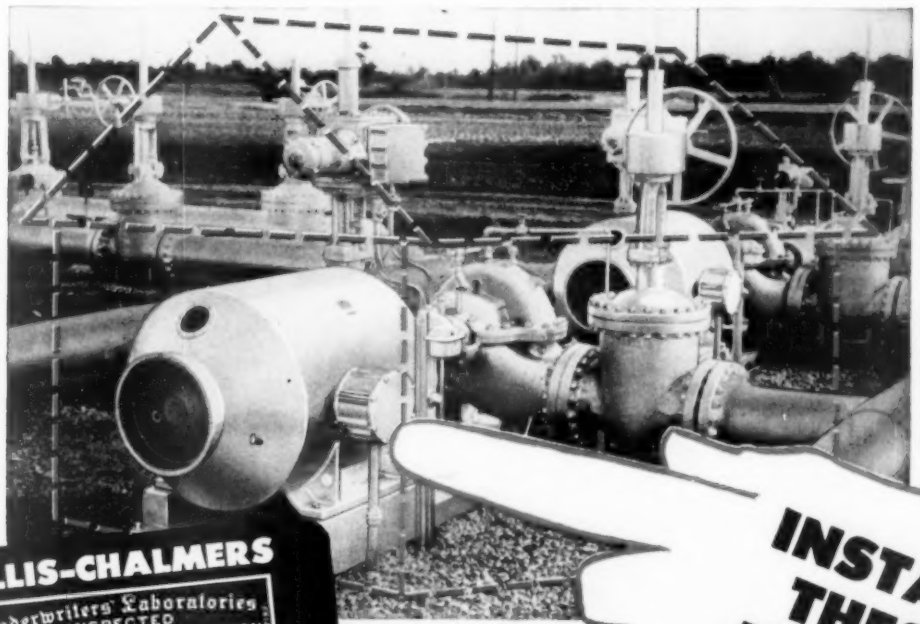

INSTALL THESE MOTORS OUTDOORS

YOU CAN ELIMINATE costly building on many different kinds of installations by using Allis-Chalmers Tube-type, Explosion-proof Motors and installing them outdoors. The motors shown here operate outdoors all year round at a midwestern pipe line booster station. Rain, snow, dirt, the weather's worst conditions, do not affect their dependable operation. And the same kind of savings can be made in hundreds of other applications in the field, on pipe lines and in the refinery.

Self-Cleaning Feature Saves Maintenance

The cooling system in this unique motor is practically self-cleaning. Cooling air is blown through straight, smooth tubes at sufficient velocity to clean out ordinary dirt, even after long shutdowns. There are no corners or pockets to trap dirt or moisture. If sticky dirt clings, a ramrod will clean the tubes in seconds without stopping the motor.

On any type of duty, indoors or out, Allis-Chalmers Tube-type, Explosion-proof Motors reduce maintenance by keeping themselves clean. Get full details from your Allis-Chalmers Authorized Distributor or District Office. Or write Allis-Chalmers, Milwaukee 1, Wis., asking for bulletin 51B7149.

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Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

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TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

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Endurance and uniformity are added to all Jones Sucker rods by controlled full length normalizing. Forging strains and heat demarcations are removed. Grain structure is refined.

Physicals of Jones nickel alloy rods are improved by both normalizing and tempering.

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LOOK FOR THE GREEN RODS

A MILLION DOLLARS... riding on a Dime!

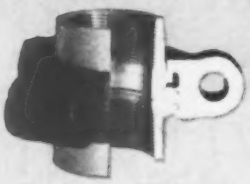

FIG. 100
1000 p.s.i.
SIZES: 2", 2½", 3", 4", 6", 8"

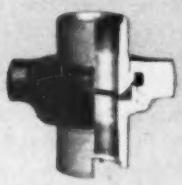

FIG. 600
6000 p.s.i.
SIZES: 1", 1½", 2", 2½", 3", 4"

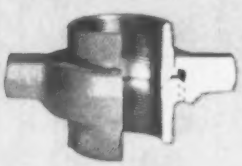

FIG. 200
2000 p.s.i.
SIZES: 1", 1¼", 1½", 2", 2½"
3", 4", 6", 8"

FIG. 602
6000 p.s.i.
SIZES: 1", 1½", 2", 3", 4"

FIG. 400
4000 p.s.i.
SIZES: 2", 2½", 3", 4", 5⅛" O.D.,
6", 7" O.D., 8", 10"

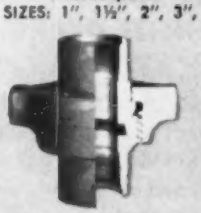

FIG. 1502
15,000 p.s.i.
SIZES: 2", 2½", 3"

● It's just good drilling practice to avoid this situation. It pays to be sure every item involved in your rig's operation measures up to the highest standard of service and trustworthy performance.

WECO UNIONS, a small item in the cost of any rig, are vitally important in its performance. You can depend on them for maximum service and trustworthy performance on fuel, steam, water, mud and flow lines; blowout preventer closing manifolds; pump suction connections; cementing lines and wherever else unions are desirable or needed on your rig.

Their ball and cone seat means a dependable, positive leak-proof seal . . . their rugged construction means longer life in roughest services . . . their extra strength means greater resistance to impact, shock and surge pressures.

There's a WECO UNION of the right size, pressure and design for every drilling rig service. Ask your WECO Representative or your supply store for the WECO UNIONS you need.

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PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION
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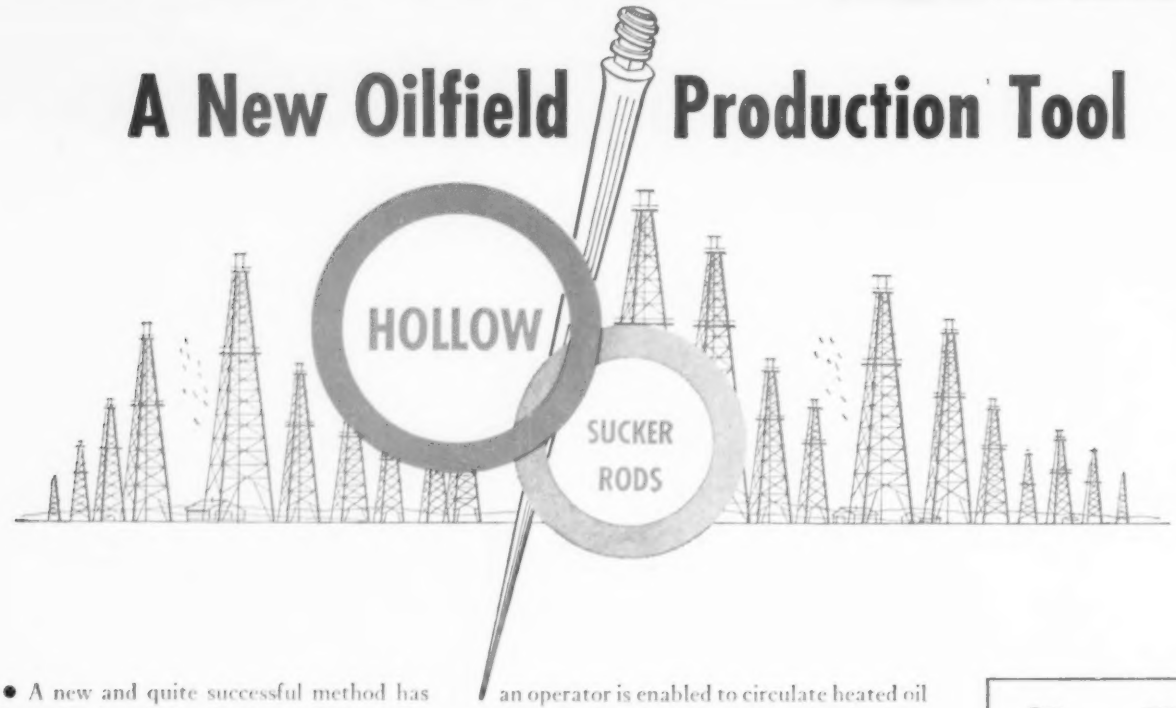
It's Wise to Standardize with... WECO...

WELL EQUIPMENT MFG. CORP.
Division of Chiksan Company
HOUSTON 1, TEXAS
CHIKSAN COMPANY
Brea, Calif. Chicago 28, Ill. Newark 2, N. J.
CHIKSAN EXPORT COMPANY, Brea, Calif. Newark 2, N. J.

Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

● MOST COMPLETE LINE OF WING UNIONS IN THE WORLD

A New Oilfield Production Tool

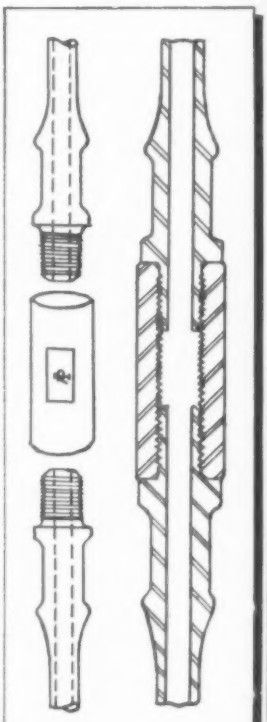


• A new and quite successful method has been developed* for the removal of paraffin or asphaltic deposits from oil wells. This troublesome problem is an expensive, time-consuming, and all-too-frequent one to production men in many of the oilfields in the United States. The loss of production and the cost of remedial work due to "waxing" problems is known to be one of the industry's major headaches connected with the production of crude oil.

By the use of the hollow sucker rod made from Shelby Seamless Mechanical Tubing, an operator is enabled to circulate heated oil down the bore hole through the inside of the hollow sucker rod and up the annulus between the rod and tubing *without interrupting the pumping of the well!* The heated oil flushes out the asphalt or wax which has become fluid and carries it out through the flow line to the tank of separator. This operation, taking only a few minutes, can be performed as a routine preventive measure without loss of production from the well instead of the conventional method of waiting until tubing or annulus is plugged with wax, then shutting down the pump and pulling and stripping the rods and tubing.

Capacity and Strength of HOLLOW SUCKER RODS made from SHELBY Seamless TUBING

The hollow sucker rod is, unless otherwise ordered, a double pin, Range 2 length of Shelby Seamless Steel Tubing having standard dimensions of 1⅛" O.D. by ⅜" I.D. with standard A.P.I. ⅞" sucker rod pins bored out and flash welded to the body of the rod. Made of A.I.S.I.-1035 steel, or equivalent, cold-drawn and finished annealed, the manufacturers of this rod say it has an adequate safety factor for wells of from 6500′ to 7500′ in depth and having polish rods loads of 17,000 to 20,000 pounds.



Sketch of hollow sucker rod showing double pin construction and standard A.P.I. couplings.

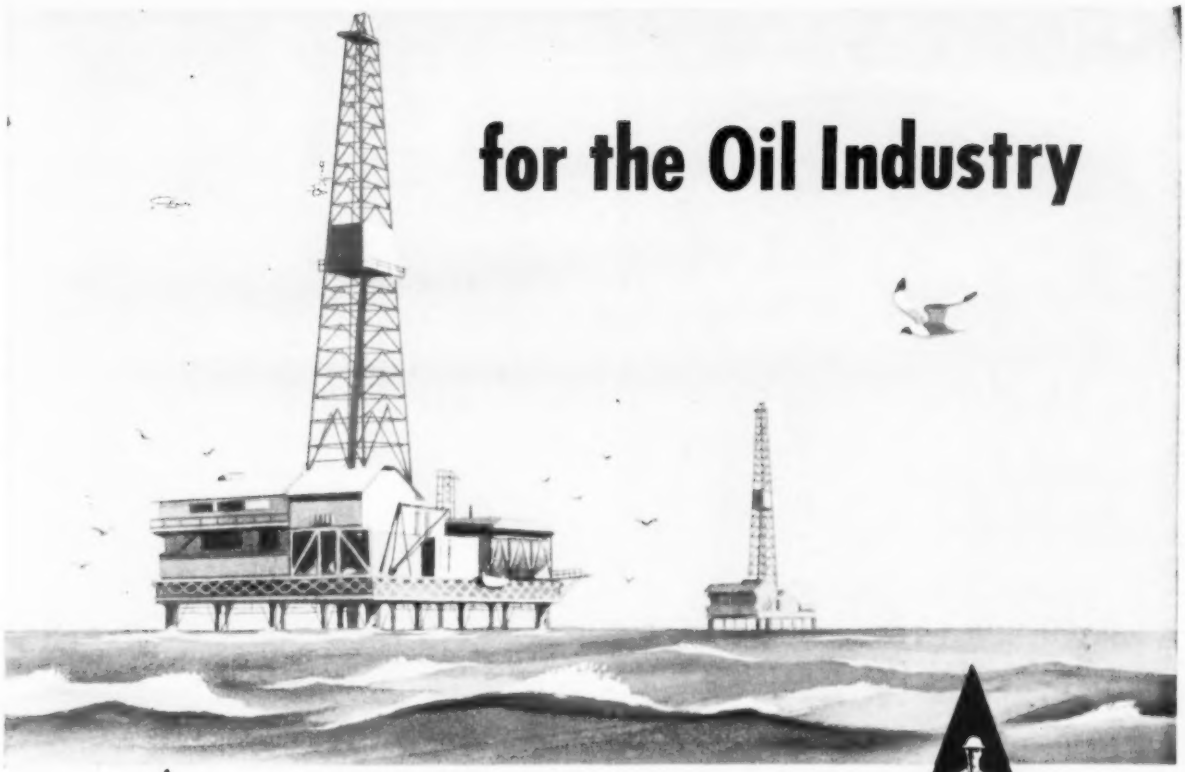
*Manufacturer's name on request.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

SHELBY SEAMLESS MECHANICAL TUBING

UNITED STATES STEEL



for the Oil Industry

AVONDALE

3 facilities to serve you

MAIN YARD at Avondale, Louisiana for ship and barge building and repairs, tank cleaning, steel fabrication, and pipe-joint platforms for offshore drilling.

HARVEY YARD at Harvey, Louisiana for quick repairs, drydocking, and propeller service.

SERVICE FOUNDRY (Foundry Division) in New Orleans for iron, steel and non ferrous castings, cut gears, and large capacity machine work.

Complete facilities for a well-rounded service to the Oil Industry

Service - Integrity - Efficiency

AVONDALE MARINE WAYS, INC.

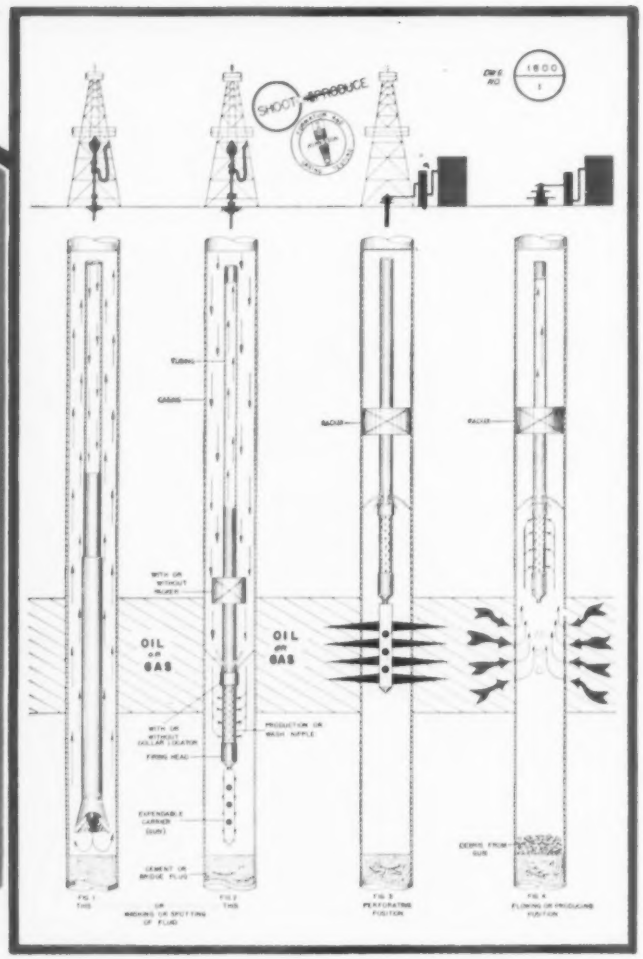
P. O. BOX 1030, NEW ORLEANS 8, U.S.A.

MAIN PLANT	"QUICK REPAIR PLANT"	SERVICE FOUNDRY
Avondale, La. • UNiversity 4561	Harvey, La. • EDison 4211	416 Erato St.—New Orleans • CAnal 3836

SHORT STORY

of how JOHNSTON'S SHOOT and PRODUCE METHOD... CONTRIBUTES to...

- MORE SAFETY
- MORE ECONOMY
- MORE EFFICIENCY
- DEEPER PENETRATION IN WELL COMPLETION



• With the Johnston Shoot and Produce equipment it is possible to lower hydrostatic pressure below reservoir pressure and position the desired fluid opposite the reservoir with the Christmas Tree and surface connections completed and the well fully under control before perforating.

Drawing No. 1800-1 shows the procedure used in the Shoot and Produce method. Fig. 1 shows casing has been cemented; the "Running-In-String" used for drilling and cleaning out to bottom can be used for displacing drilling mud with other fluids as oil and water, or spotting these fluids before pulling it to the surface. Fig. 2 shows a second method, with the Expendable Gun, Firing Head, Perforated Nipple, with or without Collar Locator, and with or without Production Packer in position for locating collars and displacing drilling mud with desirable fluids, or spotting other fluids. Fig. 3 shows perforating equipment in position, with or without packer, and Christmas Tree and surface equipment fully installed. The well is perforated by dropping the "Go-Devil" which shears Disc in Firing Head and exposes hydrostatic fluid pressure to piston in Firing Head which detonates the Expendable Gun. Fig. 4 shows production string and surface connections after perforation, with the well free to produce and debris on bottom.

JOHNSTON TESTERS, INC.

POST OFFICE BOX 165 HOUSTON, TEXAS

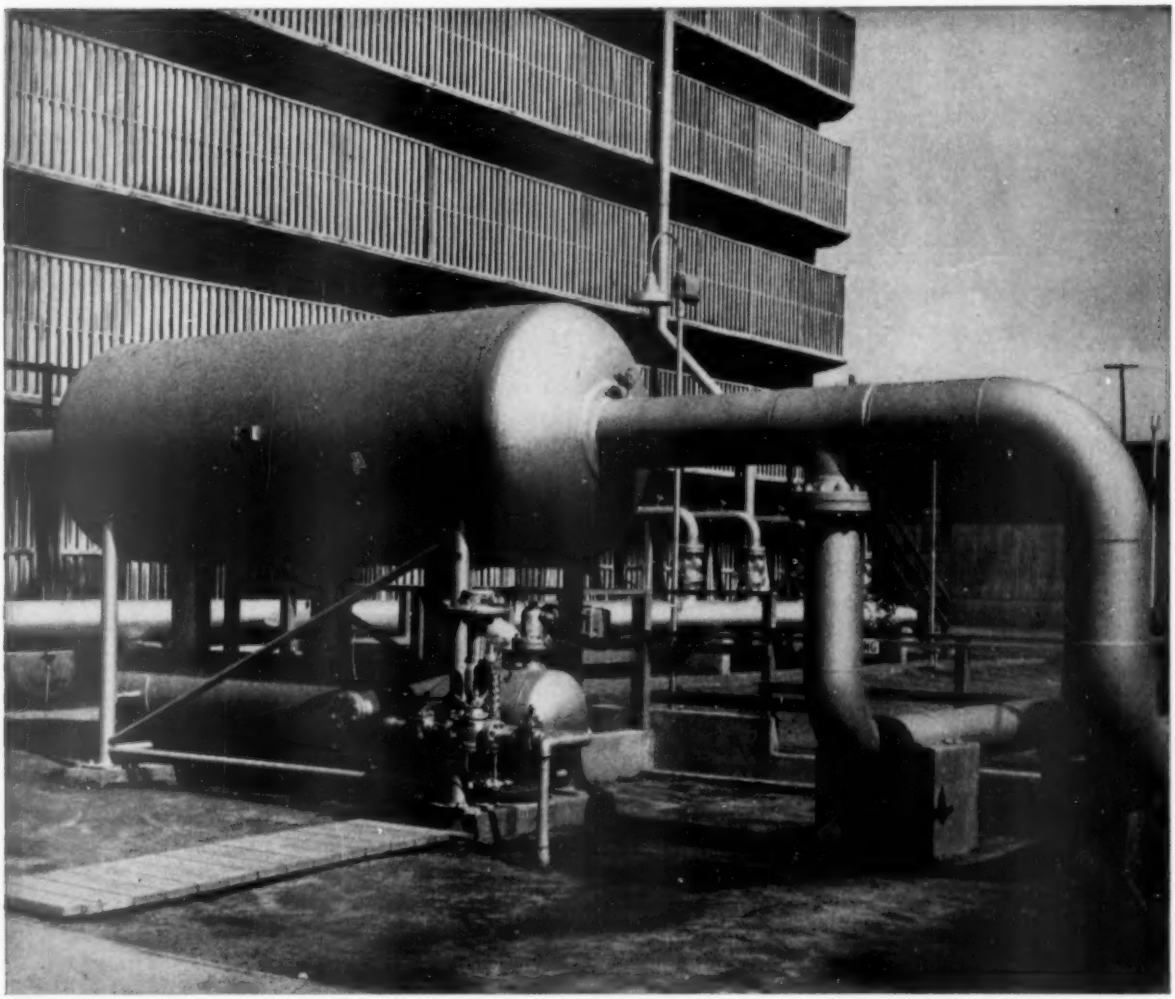
EXPORT DIVISION: 3035 Andrita St., Los Angeles 65, California

SERVICE BRANCHES IN ALL ACTIVE AREAS

There's a Johnston Service Representative Near You

FORMATION AND CASING TESTING — JOHNSTON

See PEERLESS FIRST!
For GAS SCRUBBERS...



The **BEST SCRUBBERS** for PIPELINES, GATHERING SYSTEMS, COMPRESSOR STATIONS, PLANT INLET SCRUBBERS

Pictured above is a Peerless 60" O.D. x 15 foot horizontal separator, handling 240,000,000 cu. ft. per day at 350#.

This separator is removing condensed liquid from the cooling tower to prevent moisture accumulation in distribution units.

Consult Peerless for an engineered solution to your most stringent entrainment problems.

PEERLESS MFG. CO.

PEERLESS MANUFACTURING CO.

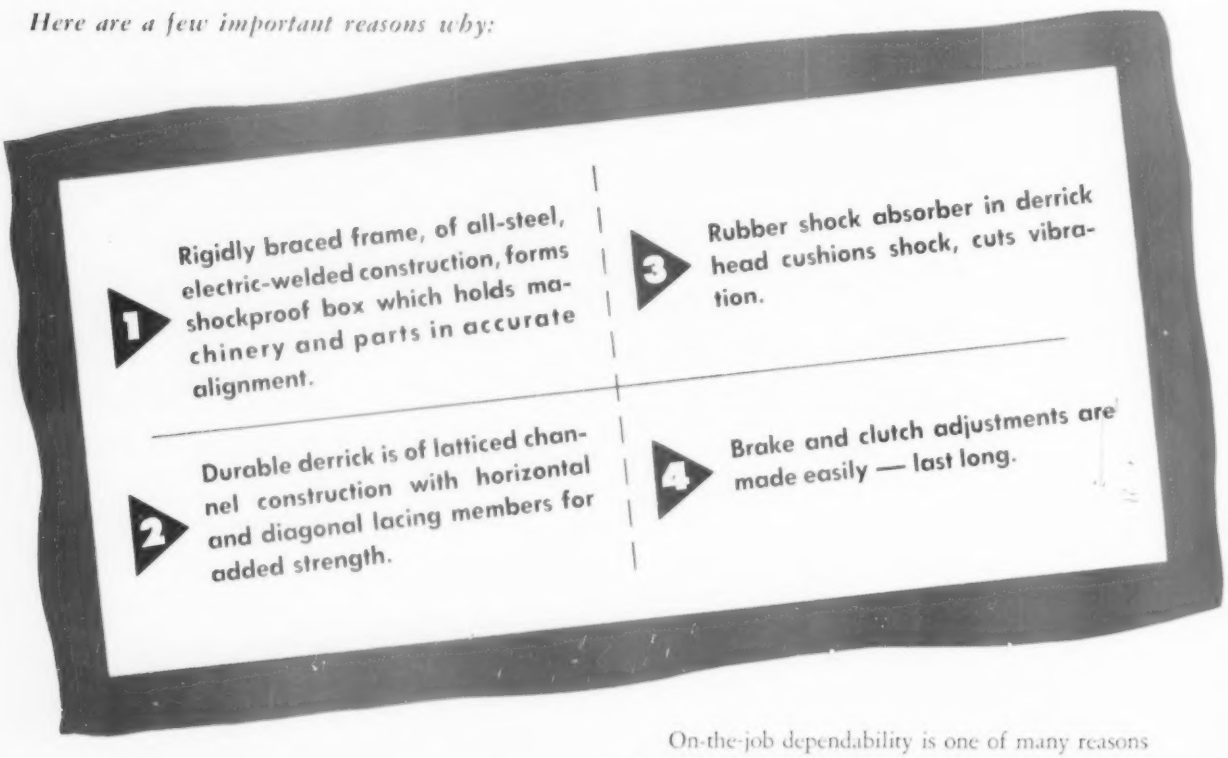
P. O. BOX 7193 ★ DALLAS, TEXAS ★ Dixon-8431

REPRESENTATIVES IN ALL PRINCIPAL CITIES

always on the job making money for

Steady, dependable performance . . . that's what you get with Bucyrus-Erie spudders, whether the job is top-to-bottom drilling, workover, or tailing-in after rotaries. These modern mobile rigs are built to last, built to stand up to a steady diet of tough duty, with minimum time out for maintenance or repairs.

Here are a few important reasons why:


1
Rigidly braced frame, of all-steel, electric-welded construction, forms shockproof box which holds machinery and parts in accurate alignment.
2
Durable derrick is of latticed channel construction with horizontal and diagonal lacing members for added strength.
3
Rubber shock absorber in derrick head cushions shock, cuts vibration.
4
Brake and clutch adjustments are made easily — last long.

On-the-job dependability is one of many reasons why Bucyrus-Erie spudders lead the field. Your nearby distributor will be happy to tell you about the many additional reasons. See him soon!

6553C

BUCYRUS-ERIE COMPANY • South Milwaukee, Wisconsin

you
BUCYRUS ERIE
FIRST with the Finest in Spudders

Helping You Cut Fire Losses

As leading manufacturers of fire fighting equipment, Rockwood makes many products that contribute vitally to the quick extinguishment or effective control of all kinds of fires. On this page are representative Rockwood products that daily play a vital role in fire protection programs throughout the nation.

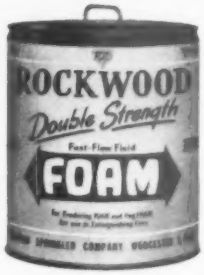
For further details on these products, and many, many others, write for your free copy of the Rockwood Catalog, "Fire Fighting Products." ROCKWOOD SPRINKLER COMPANY, 104 HARLOW STREET, WORCESTER 5, MASS. Distributors in all principal cities.

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY

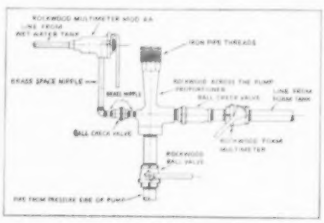
Engineers Water . . .
to Cut Fire Losses

Type SG-48 WaterFOG Nozzle. Easy to handle. Discharges high or low velocity WaterFOG or straight water stream.



Double Strength Foam Liquid for fire hose line Nozzles and permanently piped FogFOAM and FOAM installations.

Type FFF FogFOAM Nozzle. Discharges FogFOAM, Solid FOAM stream, and High Velocity WaterFOG.

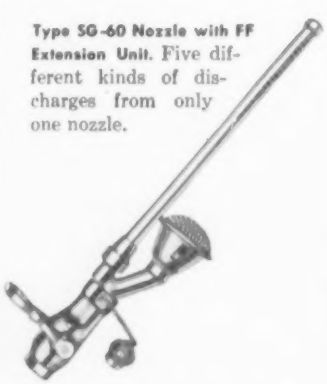


Proportioning systems. Used when pressure is maintained by pump. Custom-engineered systems also available.

Foam Eductor. Introduces FOAM liquid into hose lines. Used with Type FFF FogFOAM Nozzles.

High Capacity WaterFOG Nozzle. Quickly controls and extinguishes large fires in buildings and flammable liquids.

Type SG-60 Nozzle with FF Extension Unit. Five different kinds of discharges from only one nozzle.



Hydraulically or Manually Controlled Type FFF FogFOAM Turret Nozzle for airport crash fire fighting trucks and others.

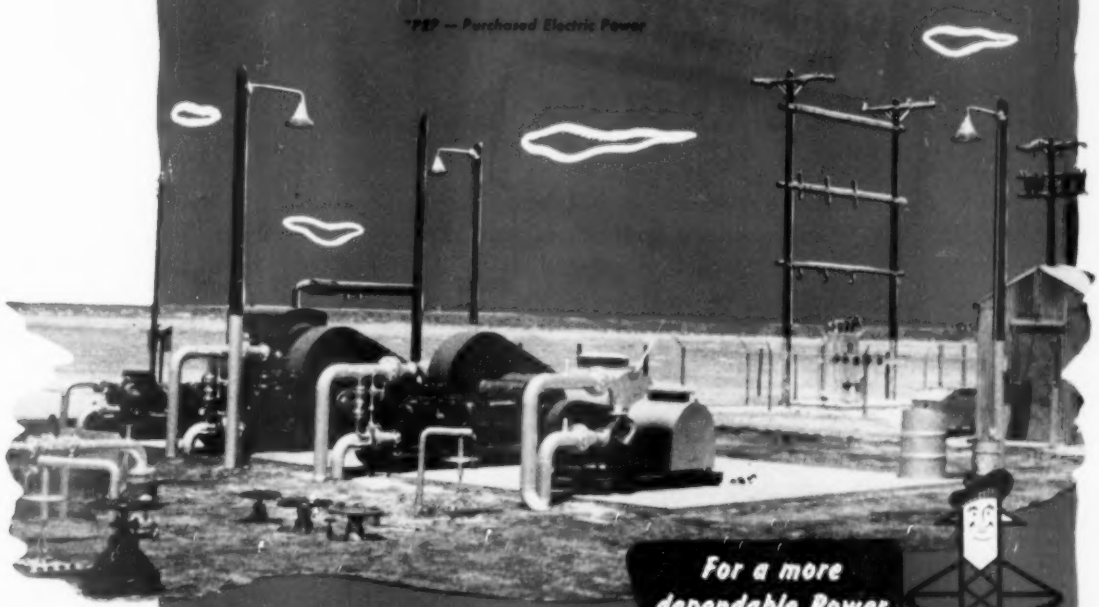
ANOTHER *Electric Power* CASE HISTORY

MOVIN' IT WITH ECONOMICAL PURCHASED *Electric Power*

The major Pipeline company operating this gathering station in the Permian Basin, reports that Electrically Powered equipment has been a sound investment in economy, performance, and dependability. Thousands upon thousands of installations, such as this, are depending on Electric Power because today Electric Power is performing a *better service for less.*

Low Cost Purchased Electric Power can do a job for you. Make it "PEP . . . in '53; call the Power Engineer at your nearest Electric Power Company . . . TODAY!

"PEP — Purchased Electric Power



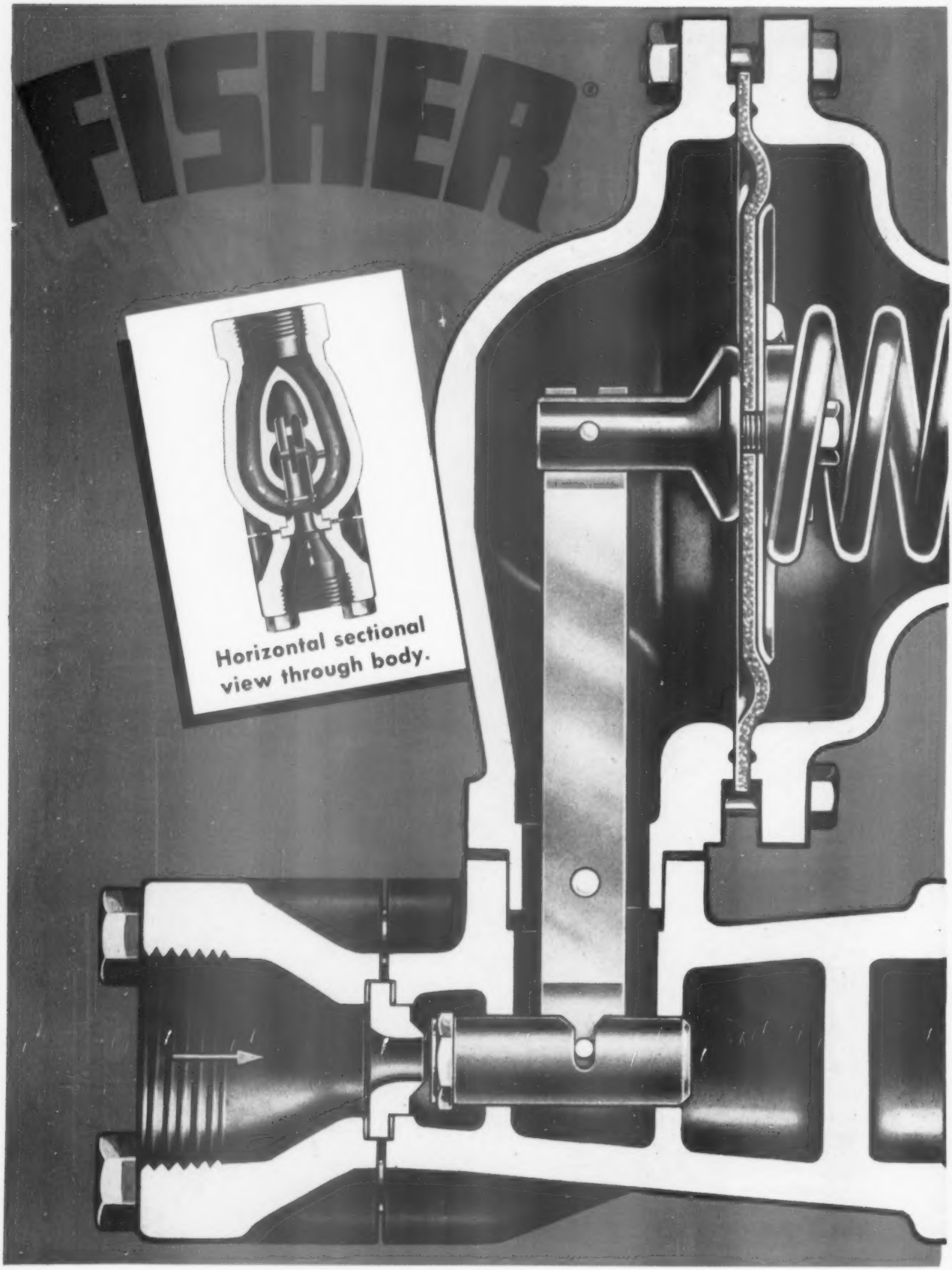
For a more dependable Power make it "PEP in '53

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

Our 25th Year

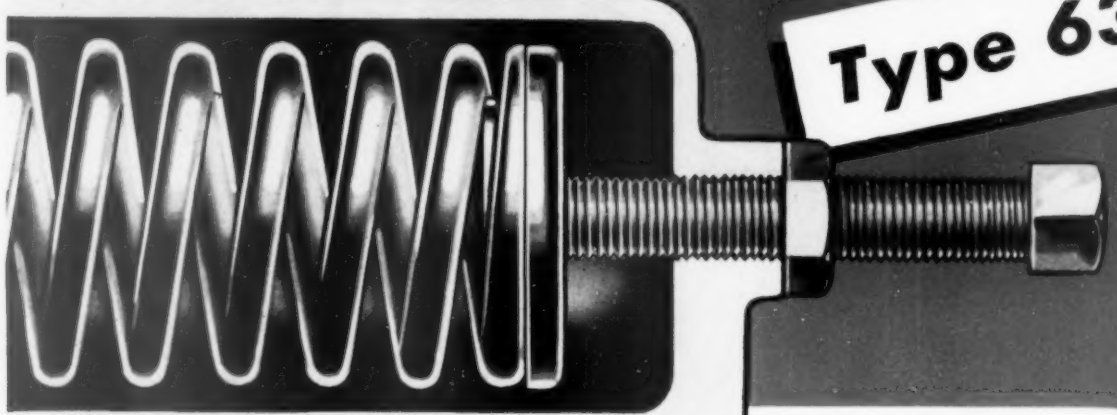
Petroleum Electric Power Association

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY FOR MORE FACTS OR ADDRESS YOUR REQUEST TO P. O. BOX 2771, DALLAS, TEXAS


FISHER®
Horizontal sectional view through body.

BIG JOE

Type 630



The gas man's First Choice for pounds to pounds service

Fisher's famous Big Joe Type 630 is the best regulator the industry has for rugged high pressure jobs. It's ideal for farm taps, small border stations, field lease work and production equipment applications. For completely dependable service, there is no regulator like the Big Joe — it's backed by thousands upon thousands of installations.

Available in 1" and 2" sizes for inlet pressures up to 1000 PSI and outlet pressures 5 PSI to 200 PSI.

WRITE FOR BULLETIN P-10A

FISHER GOVERNOR COMPANY

MARSHALLTOWN, IOWA

FISHER LEADS THE INDUSTRY IN RESEARCH FOR BETTER GAS PRESSURE CONTROL

HOW IMPORTANT IS SERVICE?

At Tretolite we believe that efficient dehydrating *service* is just as important as an effective dehydrating *chemical*.

We believe Tret-O-lite dehydrating chemicals are the best obtainable, and that their use will result in the maximum in barrels of pipe-line oil at a minimum chemical cost. However, to assure this, there is a Tretolite service engineer in, or close to, every production area.

Tretolite service engineers are located all over the oil world because years of experience have shown that even the best dehydrating chemicals must be correctly applied to deliver top dehydrating performance.

You can easily prove these statements to your own satisfaction—just call the Tretolite service engineer in your area when you have an emulsion problem.

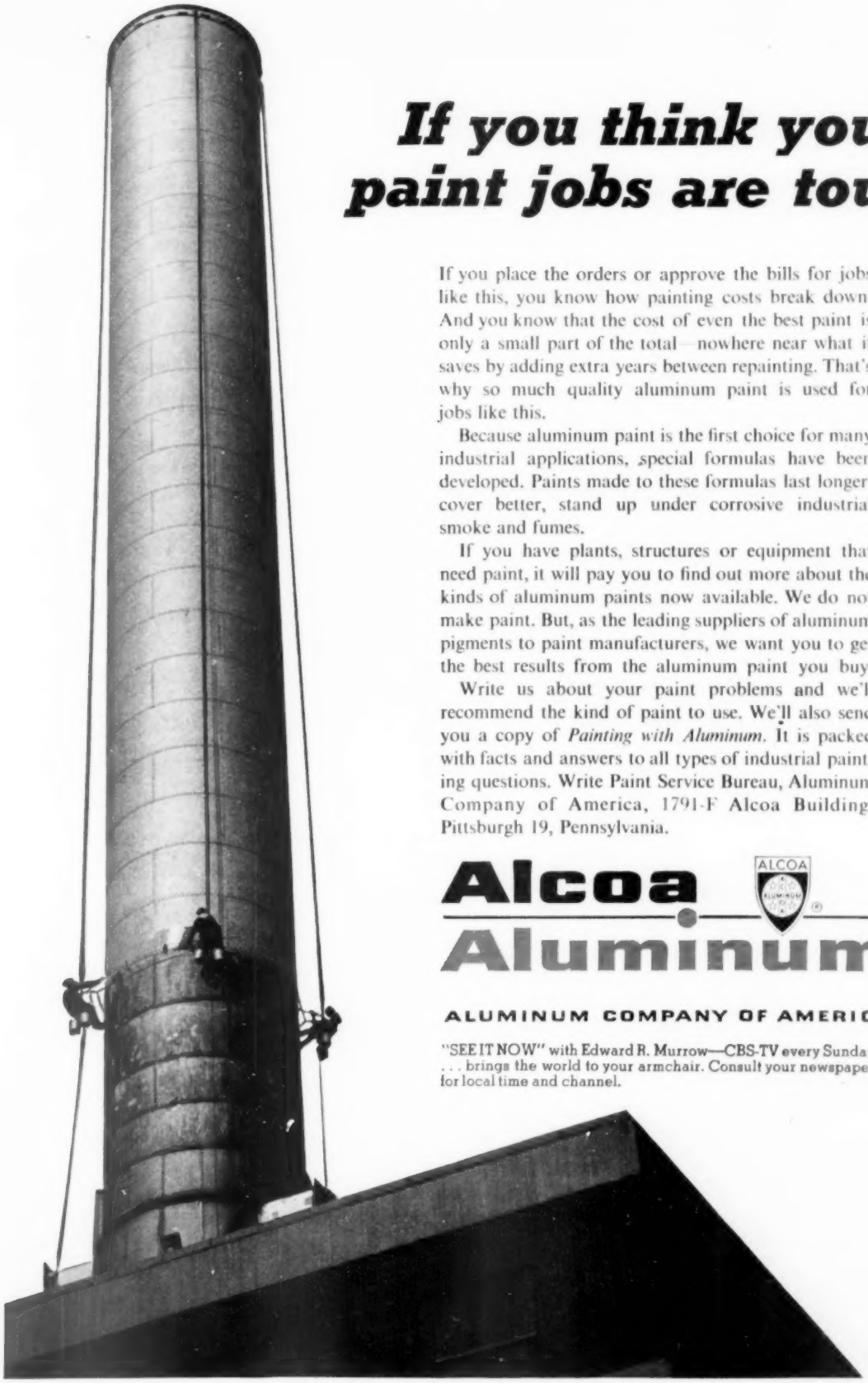
T93-2

TRETOLITE COMPANY

Chemicals and Services for the Petroleum Industry

SAINT LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

DEHYDRATING • DESALTING • CORROSION INHIBITING
SCALE PREVENTING • PARAFFIN REMOVING • WATER DE-OILING



If you think your paint jobs are tough

If you place the orders or approve the bills for jobs like this, you know how painting costs break down. And you know that the cost of even the best paint is only a small part of the total—nowhere near what it saves by adding extra years between repainting. That's why so much quality aluminum paint is used for jobs like this.

Because aluminum paint is the first choice for many industrial applications, special formulas have been developed. Paints made to these formulas last longer, cover better, stand up under corrosive industrial smoke and fumes.

If you have plants, structures or equipment that need paint, it will pay you to find out more about the kinds of aluminum paints now available. We do not make paint. But, as the leading suppliers of aluminum pigments to paint manufacturers, we want you to get the best results from the aluminum paint you buy.

Write us about your paint problems and we'll recommend the kind of paint to use. We'll also send you a copy of *Painting with Aluminum*. It is packed with facts and answers to all types of industrial painting questions. Write Paint Service Bureau, Aluminum Company of America, 1791-F Alcoa Building, Pittsburgh 19, Pennsylvania.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

"SEE IT NOW" with Edward R. Murrow—CBS-TV every Sunday . . . brings the world to your armchair. Consult your newspaper for local time and channel.

Including these features

LE GRAND

Pumping Units are in service in many of the World's oilfields. They have many attractive features which make them the ideal choice for all pumping conditions.

Le Grand—O.C.T. wellhead and flow control equipment in a wide pressure range to suit all types of well is also manufactured under license from the Oil Center Tool Co., Houston, Texas, U.S.A.

Details of our complete range of equipment will be sent with pleasure upon request.

LE GRAND, SUTCLIFF & GELL, LTD.

HORSTED AIRPORT, ROCHESTER, KENT, ENGLAND.

Represented in the following areas by agents who will be pleased to assist you.

TRINIDAD:-
The Industrial Agencies Ltd.,
14 High Street,
San Fernando.

EASTERN VENEZUELA:-
A-Z Export S.A.
Apartado 4026,
Puerto La Cruz

WESTERN VENEZUELA:-
A-Z Export S.A.,
Apartado 304,
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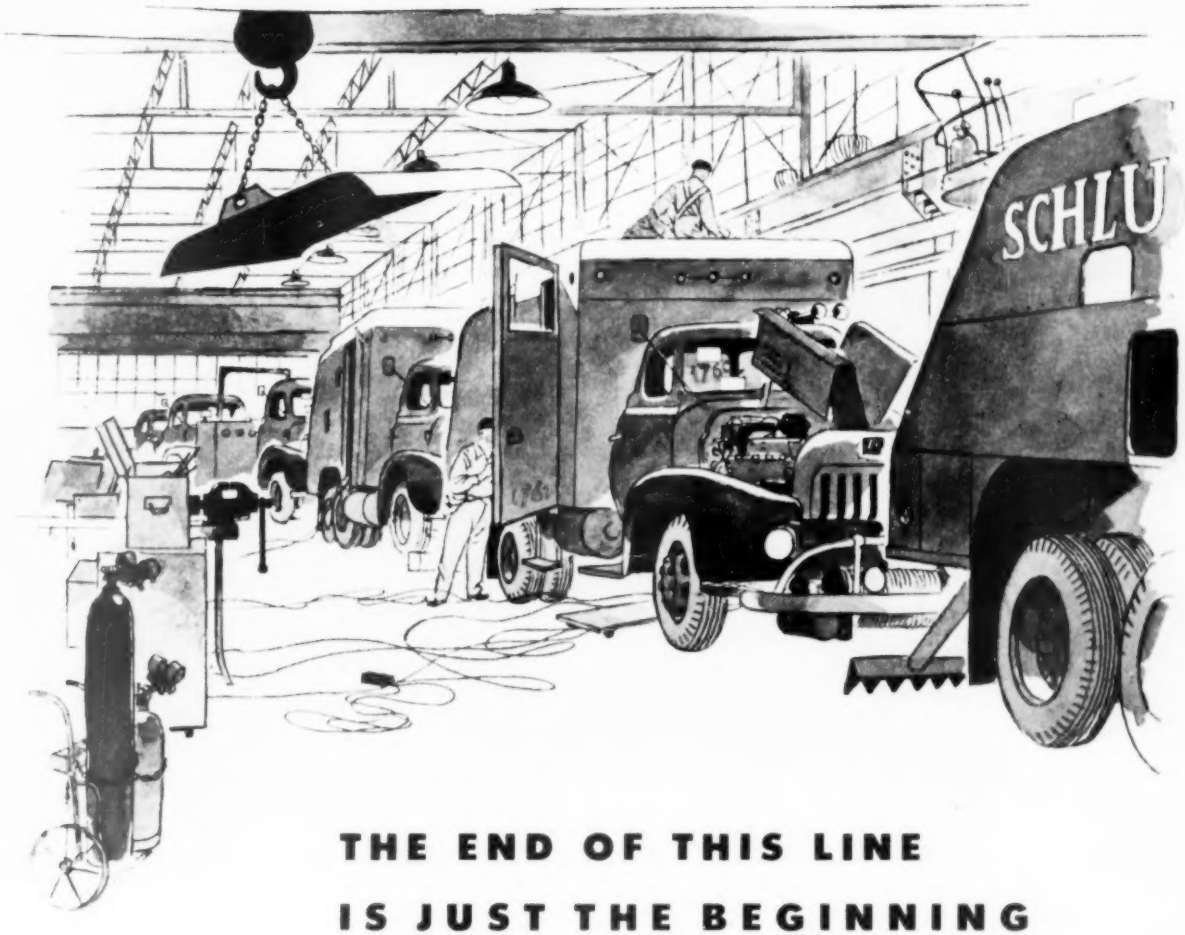
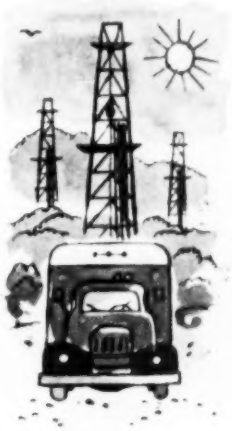


THE END OF THIS LINE IS JUST THE BEGINNING

When a Schlumberger truck rolls off this production line in the new Headquarters at Houston, it is dispatched to one of more than ninety field branches in the United States and Canada. Each unit is equipped to provide uniformly fine service under all conditions wherever it operates.



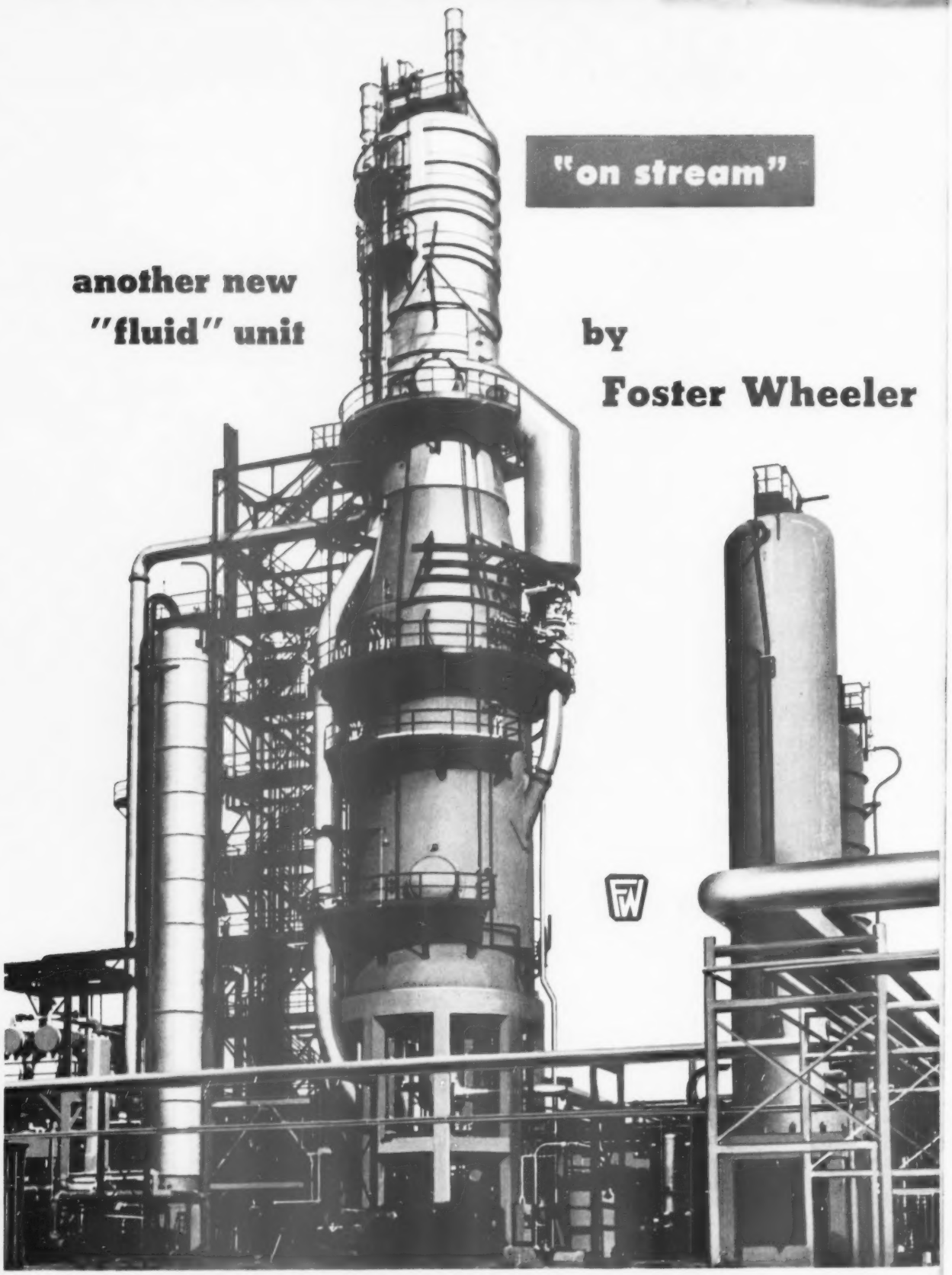
SCHLUMBERGER

WELL SURVEYING CORPORATION — HOUSTON

"on stream"

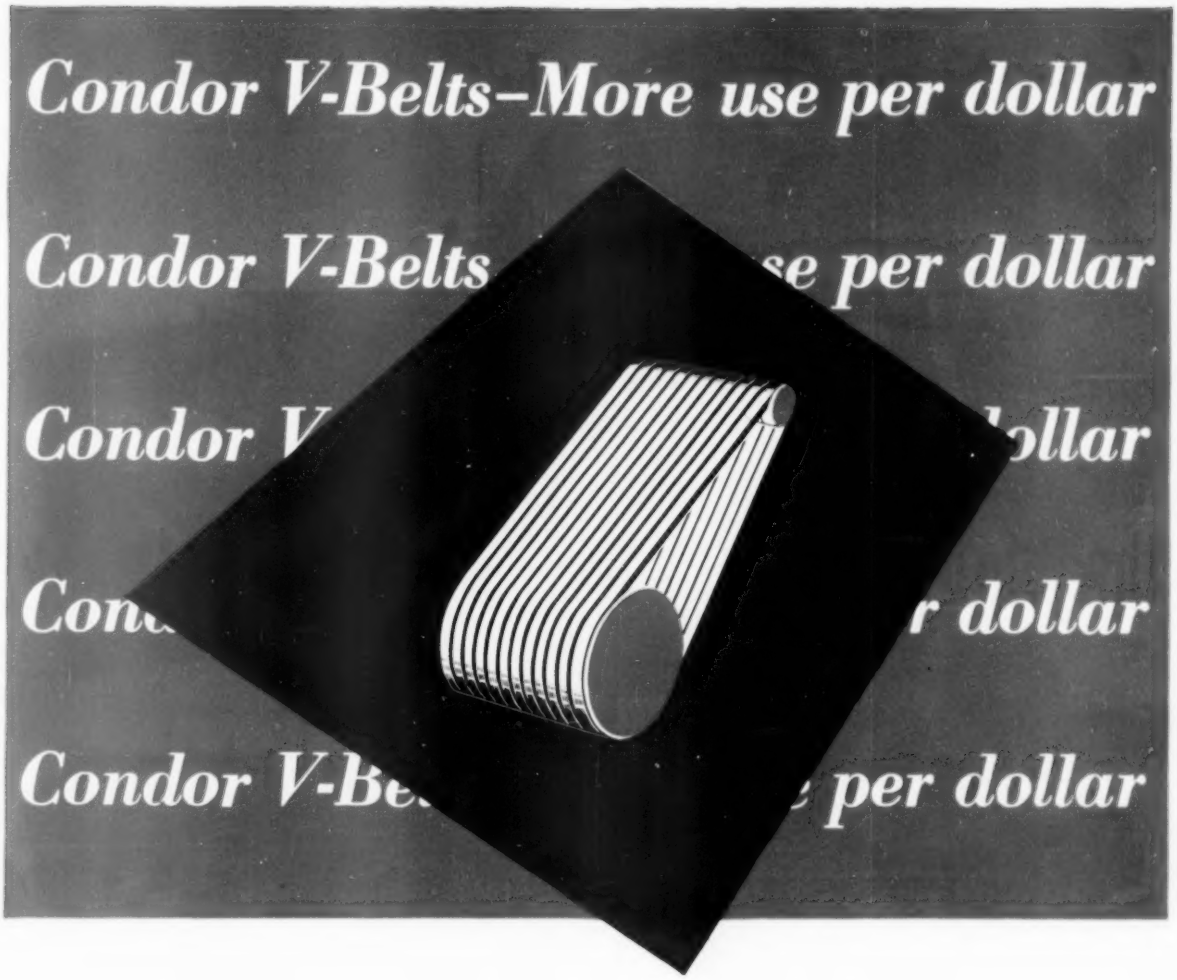
another new
"fluid" unit

by
Foster Wheeler



Designers and constructors of all types of petroleum refining and petrochemical processing units. Complete engineering facilities at:—

LONDON PARIS NEW YORK ST. CATHARINES, ONTARIO HOUSTON, TEXAS



MORE GRIP, LESS SLIP, LONGER LIFE . . . . Yes, you save money with Condor V-Belts on even the toughest multiple belt drive. Straight sidewalls provide more grip, less slip, longer life. They are the smoothest running V-Belts made, because every part is precision-balanced in manufacture. This, too, means longer life. Also in special oil-, heat-, static-resisting types . . . Get the engineering facts. Ask the R/M distributor for Bulletin 6868 . . . He'll tell you, too, how you get MORE USE PER DOLLAR with R/M hose, transmission and conveyor belts.

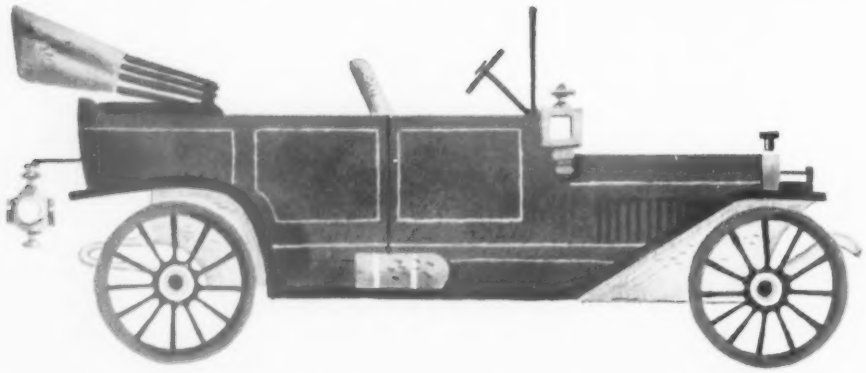
RM

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

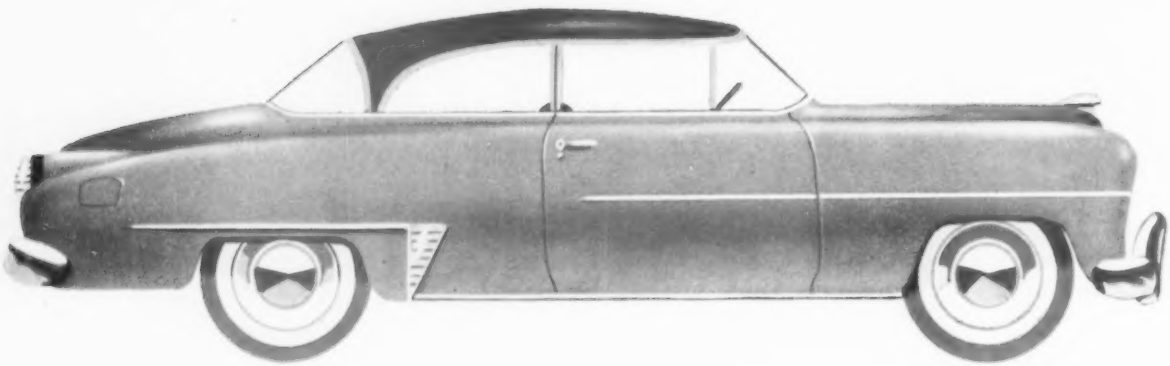
RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls

A big difference? Sure . . . but



the biggest difference is in the gas tank!



COMPARE THE MODERN CAR with the rustic runabout of 1910.

Compare their horsepower, speed, acceleration, fuel consumption. What makes the modern car so much better? What makes it so much more powerful, so much faster, able to stand up better under all conditions?

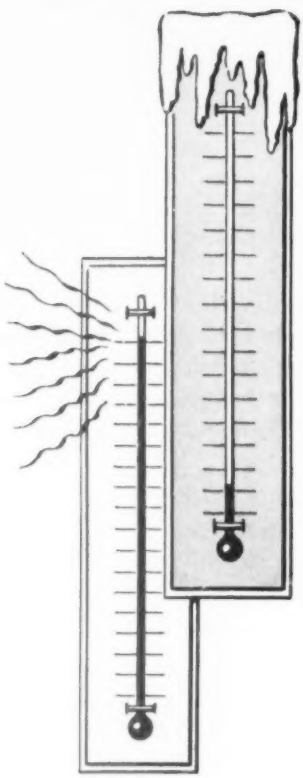
Petroleum!

New lubricants reduce engine wear as much as 40 percent . . . allow quick easy starts and miles of safe driving in all kinds of weather. Two gallons of today's gasoline do the work that three gallons did in 1925 . . . are actually worth more by 50 percent in performance and economy. Yet gasoline costs no more now than it did then...only the *taxes* are higher.

Cities Service is proud of the part it has played in developing more than 400 quality petroleum products during the last 80 years . . . products that serve the individual, his home, his farm, his factory . . . and the nation.

CITIES SERVICE

Quality Petroleum Products



Make heavy oil flow freely in winter as in summer

G-Fin Heaters assure ready withdrawal of fuel oil, lube oil, crude oil, tar or asphalt from storage tanks no matter how cold the weather.

EFFICIENT . . . *use less steam* because only the oil at point of withdrawal from the tank is heated . . . *greatest heating effectiveness* because the G-Fin heating elements have over six times more heating surface than bare tubes of the same size . . . *least pressure drop* because of the straight-through flow of oil.

LOW MAINTENANCE . . . *fewest tube joints* because of the small number of G-Fin elements . . . *easily examined* because the cover can be removed for inspection of tube joints while the tank is full of oil . . . *quickly cleaned* because of few tubes and complete accessibility of entire length and diameter of tubes.

DURABLE . . . *leakproof joints* because of metal-to-metal contact between conical tube ends and tube sheet made tight by accurate machining and held tight by lock-nuts . . . *no temperature strains* because U-bend tubes are free to expand and contract.

These units are built in a large range of sizes and in two designs for installation partly within or entirely outside of tank.

Write for descriptive bulletin.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R
HEAT TRANSFER APPARATUS

G-Fin Storage Tank Oil Heater

GR-318

ONLY $270 BUYS A PACKAGE OF FULLY AUTOMATIC FIRE PROTECTION

Anyone who can measure volume . . . and can cut pipe . . . can install this ready-made fully automatic fire extinguishing system that requires no power source.

It includes Kidde's split-second rate-of-temperature-rise heat detector (the fastest detection known to the fire-fighting industry), Kidde's powerful Multijet nozzle and a 50-pound cylinder of fire-killing carbon dioxide. You even get a monometer tester. Pipe and fittings are optional.

Six Kidde Standard Paks are available for volumes from 800 up to 6,000 cubic feet.

All components of Kidde Standard Paks are the same as those used in Kidde custom-designed installations. The difference is that Kidde has pre-engineered the Paks for small hazards. And the savings on volume distribution are passed on to you!

You just can't beat Kidde Standard Paks for inexpensive night-and-day protection against normal flammable liquid hazards.

Remember, fire won't wait till you're ready. Better write today for full information.

Kidde

Walter Kidde & Company, Inc.
655 Main St., Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

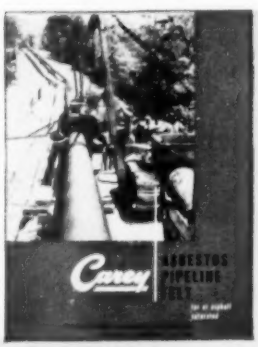
If YOUR JOB INVOLVES

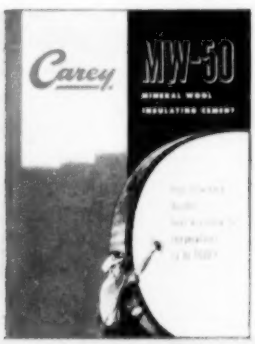
- oil or gas pipelines
- processing operations
- refinery construction or maintenance...

You need this helpful literature!

Asbestos pipeline felt data book...

a discussion of protective coatings for pipelines by a competent corrosion engineer. Covers the fundamentals of low cost, dependable pipeline protection. Timely, informative, fully illustrated.



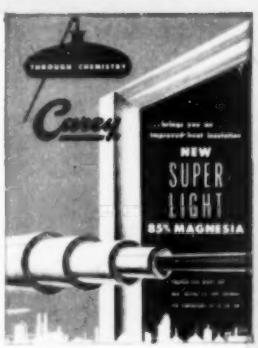


Carey MW-50 data book...

describes the most modern method for insulating all types of heated equipment having temperature ranges up to 1600°F., and gives details for applying insulation on irregular or hard-to-reach surfaces.

Super-Light 85% magnesia data book...

description, specifications and recommended uses for a new, improved insulation in precision-sized monolithic blocks, molded pipe coverings and cements.



Careystone corrugated asbestos-cement roofing and siding data book...

technical data, application details and specifications covering the economical use of Careystone asbestos-cement for all types of buildings.

Get the Carey Data Books you need absolutely free. Ask your Carey Industrial Sales Engineer, or just fill in coupon and mail today. No obligation!

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THE PHILIP CAREY MFG. CO., LOCKLAND, CINCINNATI 15, OHIO
IN CANADA: THE PHILIP CAREY CO., LTD. 277 DUKE ST. MONTREAL 3, P.Q.

The Philip Carey Mfg. Co.
Lockland, Cincinnati 15, Ohio
Department OGJ-6

Gentlemen: Please send me without charge the Carey Data Books on ☐ PipelineFelt ☐ Super-Light 85% Magnesia Insulation ☐ MW-50 Cement ☐ Careystone Asbestos-Cement Roofing and Siding. Place check mark in box before Data Books wanted.)

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Position _____
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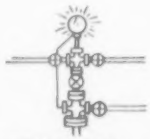
"Inside information" like this → on rock pressure trends PAYS DIVIDENDS

By keeping continuous, accurate records of significant trends in tubing and casing pressure, Foxboro Pressure Recorders can help you plan oil well operations most efficiently. They give important "inside information" on the life expectancy of wells . . . information that you can use advantageously as a work guide.

Built to withstand all sorts of weather conditions, Foxboro Pressure Recorders are ideally suited to the job. Their compact, die-cast aluminum case is weatherproof. Their sturdy, precision construction assures long service life and lasting accuracy. Typical features that have made them so valuable to oil production are shown below.

Get all the facts about these high-fidelity Tubing and Casing Pressure Recorders. Write for Bulletin 22A.

BRIGHTEST STAR ON THE CHRISTMAS TREE



★ **All-welded, alloy steel helical movement . . .** *functions accurately, without fatigue, even under pulsating pressure.*

★ **Easy range-changing** *without disturbing piping, made possible by union connection at base of helical movement.*

★ **Dual range charts** . . . *show both tubing and casing pressures.*

★ **Two speed chart drives** . . . *available to provide a 7-day speed for normal operation and a 1-day speed for quick close checking.*

The Foxboro Company
606 Neponset Avenue
Foxboro, Mass, U.S.A.

FOXBORO
REG. U. S. PAT. OFF.

INSTRUMENTS FOR OIL PRODUCTION

DEPENDABILITY IN CATALYSTS CANNOT BE SEEN

Top uniformity and dependability are available to you in Davison's microspheroidal (M-S*) or ground (DA-1*) synthetic fluid-type cracking catalysts. The accompanying photomicrographs show the physical characteristics of the DA-1 and new M-S catalysts produced in Davison's Cincinnati plant. Uniform physical and catalytic characteristics result from Davison's modern facilities and years of technical experience and research Experienced Davison Field Service Engineers—complete laboratory facilities—are all part of Davison Dependability—Dependability with the big "D".

*T.M.T.D.C.C.

Progress Through Chemistry

THE DAVISON CHEMICAL CORPORATION

Baltimore 3, Maryland

PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS

ARE YOUR LINES

"Under the Hammer?"

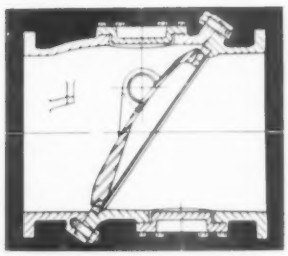
. . . here's how to get them out from under with

CHAPMAN *Tilting Disc* CHECK VALVES

Loosened pipe-joints are caused by hammering. And hammering is caused by valve-slam. But when a valve can't slam under usual piping arrangements . . . then you're free from the danger of line damage.

And this is all because of the Chapman Tilting Disc, with specially designed airfoil section that means light weight, and perfect balance in the open position, so it is easily held open in the flow . . . and then dropped quietly to a *cushioned closing* that does not even jar the line.

That's why certified tests from the country's top engineering schools and actual installations prove that Chapman Tilting Disc Check Valves reduce head-loss over regular swing-type checks. Check these tests for yourself . . . write for Catalog No. 30.



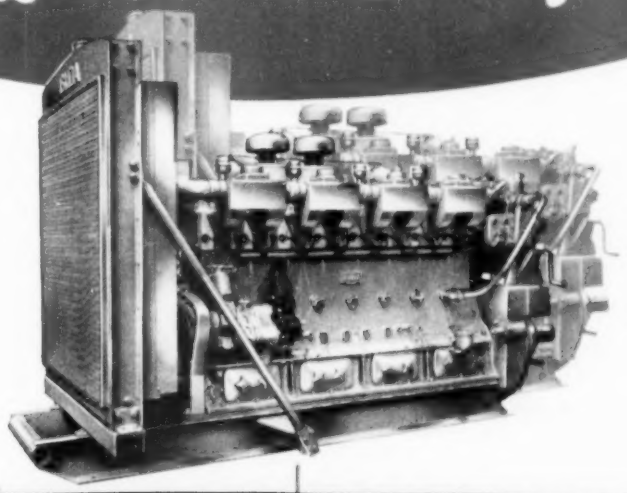
Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Mfg. Co.

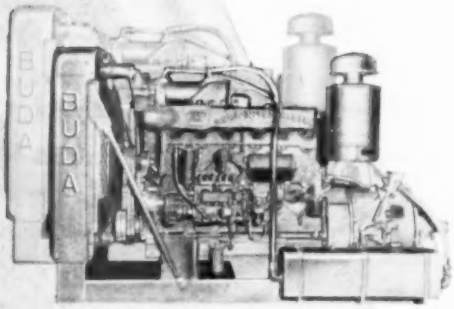
INDIAN ORCHARD, MASSACHUSETTS

Whatever Your Power Requirement

BUDA HAS IT!

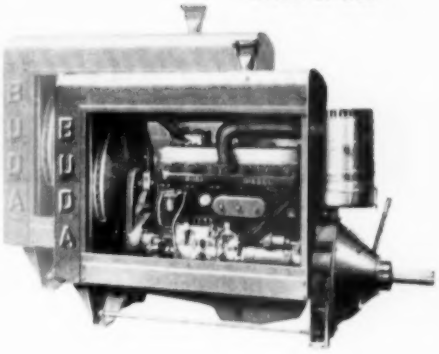


Medium Speed Heavy Duty Engines with FUECOMIZER KIT to convert from Diesel to Gas or Vice Versa



Torque Converter Power Package with High Speed Diesel or Gas Engines

High Speed Engines Diesel or Gas

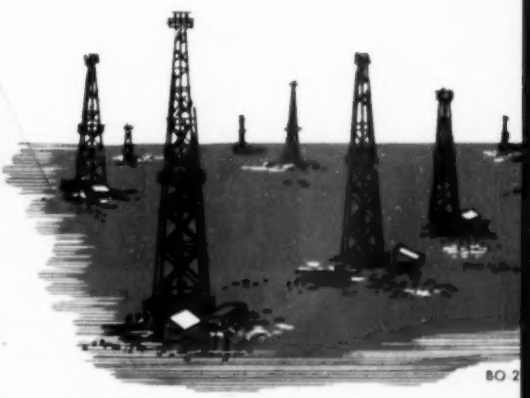


A Complete RANGE OF OILFIELD POWER

5 to 510 HP

Buda fits your Diesel or Gas power picture...whether you need a big medium speed, heavy duty convertible engine . . . a high speed engine or a torque converter "package" . . . you can buy Buda and get exactly the power you need

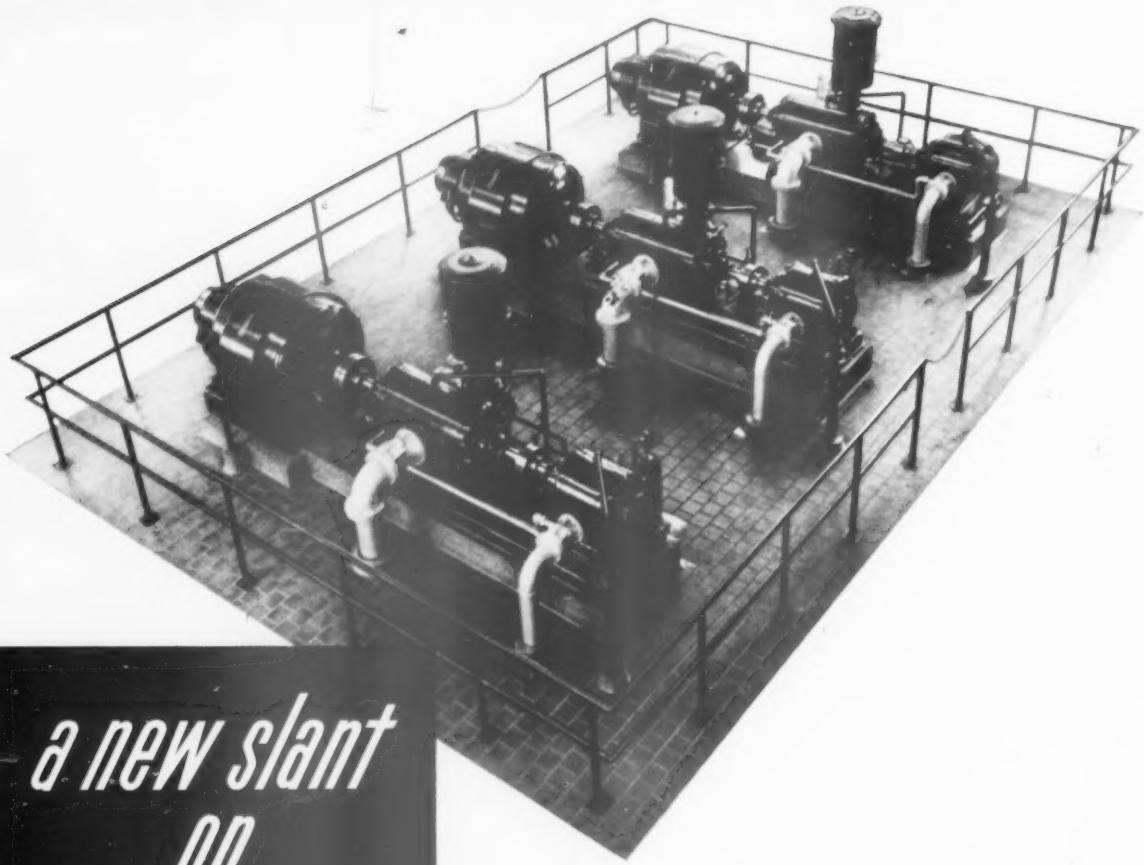
Your nearby Buda Oilfield Distributor can help you choose the right *Buda power. Ask him today.*
The Buda Company, Harvey, Illinois.



BO 2

WHEREVER THERE'S OIL THERE'S BUDA ENGINES PARTS AND SERVICE

BUDA Oilfield Distributors are located in: Dallas • Tulsa • Los Angeles • Houston • Oklahoma City • Seminole • Wichita Falls • Shreveport • Bakersfield • Tinsley • Pampa Great Bend • Long Beach • Kilgore • Mt. Carmel, Ill. • Alice • Odessa • Casper • Denver • Brookhaven • New York City (Export) and in Canada at Calgary and Edmonton



a new slant on compressors

***simple *compact *direct drive**
***valveless *vibrationless *pulseless**

If you've never considered the advantages of Fuller Rotary Compressors and Vacuum Pumps, now is the time to do so.

Fuller Rotaries have many unique and beneficial advantages for you. For instance, they can be placed almost anywhere out of the way, because their vibrationless, rotary action permits, for example, balcony installation. Because they operate by direct drive, you eliminate the initial and maintenance costs, as well as transmission losses incident to gear and belt drives. Maintenance costs are kept to a minimum.

Because Fuller Rotaries compress without reciprocating pistons, you get a non-pulsating air stream. They are extremely compact for the volume delivered; sizes to deliver up to 3300 cfm. free air, for pressures from atmosphere to 125 psig. Write today to the Fuller Company, Catasauqua, Pa. for literature and engineering data.

Fuller

FULLER COMPANY
Catasauqua, Pa.

Pioneers of high efficiency vane-type rotary compressors

Branch Offices: Chicago • San Francisco • Los Angeles • Seattle • Birmingham

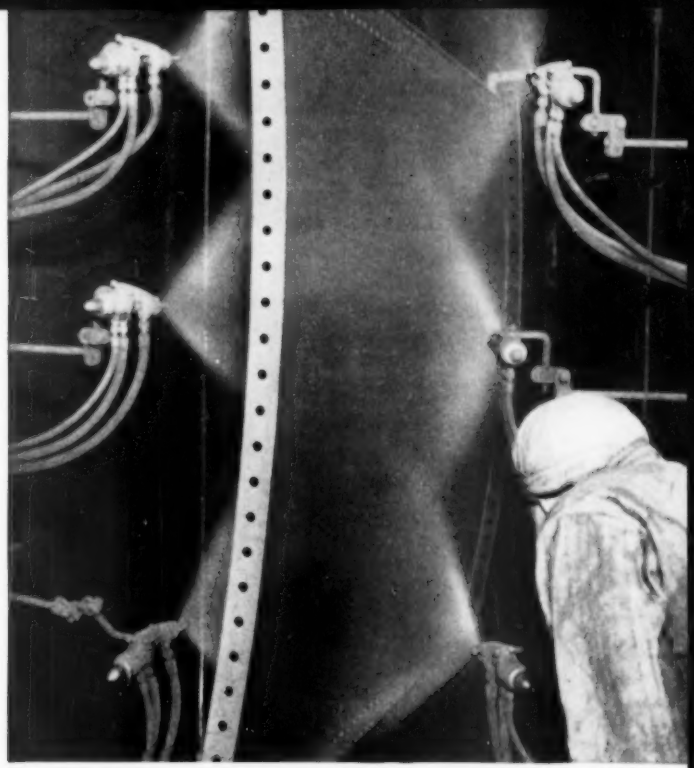
C-230
1862

For fit and finish

BUTLER

Bolted Steel Oil Tanks

- **Precision-punched bolt holes**
- **Electrostatic spray painted**



Each tank sheet is entirely coated with paint, even in the bolt holes, to prevent unnecessary corrosion on the inside and rusting on the outside. The accurate spaced bolt holes make sure each bolt carries its share of load.

Your best answer to crude or refined petroleum storage problems is the fit and finish of Butler bolted steel oil tanks. Each tank sheet is die-formed and precision-punched to assure an oil-tight fit and easier erection. A.P.I. specifications are followed on all tanks from 100 to 10,000-barrel capacity.

Tank surfaces get uniform protection with paint applied by electrostatic spray equipment under control of skilled craftsmen. Two-coat bond resists corrosion and gives Butler tanks longer life.

Fit and finish are just two of many qualities that make Butler bolted steel oil tanks your best long term buy. Steel tanks are our business, not our side-line. See your Butler distributor today.

For fast, dependable service —see your Butler Distributor

AMERICAN PIPE AND SUPPLY COMPANY
Casper, Wyoming — Denver, Colorado — Cut Bank, Montana

HARRY G. MILLER
El Dorado, Arkansas

UNION TANK AND SUPPLY COMPANY

Fort Worth, Texas	Midland, Texas	Dubach, Louisiana	Oklahoma City, Oklahoma
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Alice, Texas	Dallas, Texas	Plainville, Kansas	Sterling, Colorado
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BUTLER
STEEL PRODUCTS

OIL EQUIPMENT — STEEL BUILDINGS
FARM EQUIPMENT—CLEANERS EQUIPMENT
SPECIAL PRODUCTS

Contact your Butler distributor today or write:

BUTLER MANUFACTURING COMPANY
7464 E. 13th St., Kansas City 26, Missouri

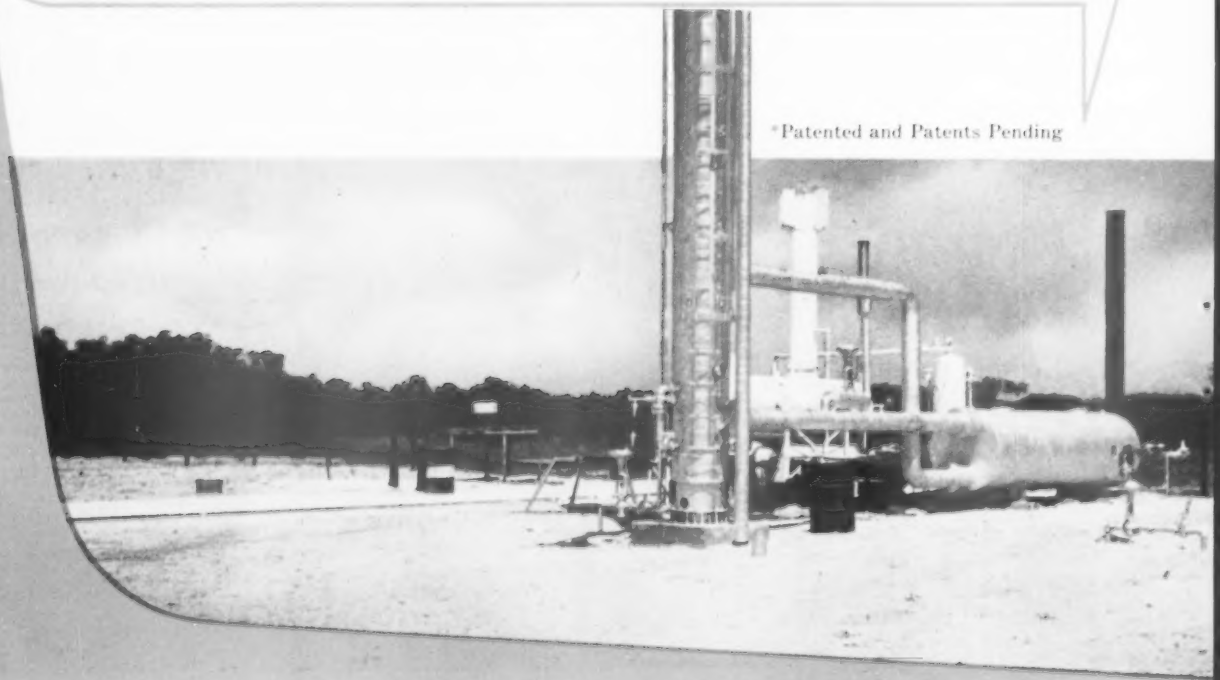
It's A Fact!

With BS&B Low Temperature Separation You Can Get

Glycol Injection System of LOW TEMPERATURE SEPARATION with STABILIZER*

...means greater profit from new wells.
...extends profitable life of old wells.

*Patented and Patents Pending



BLACK, SIVALLS & BRYSON, INC.

Oil & Gas Equipment Division, Dept. 1-A6A
2131 Westwood Boulevard Oklahoma City, Oklahoma

20 to 50% more condensate recovery!

...than with conventional two-stage separation

The BS&B Glycol Injection System with Stabilizer starts right off giving higher recovery than is possible with any other low temperature separation system. This is true, even when wells are new or have an available pressure drop of 1000 p.s.i. or more.

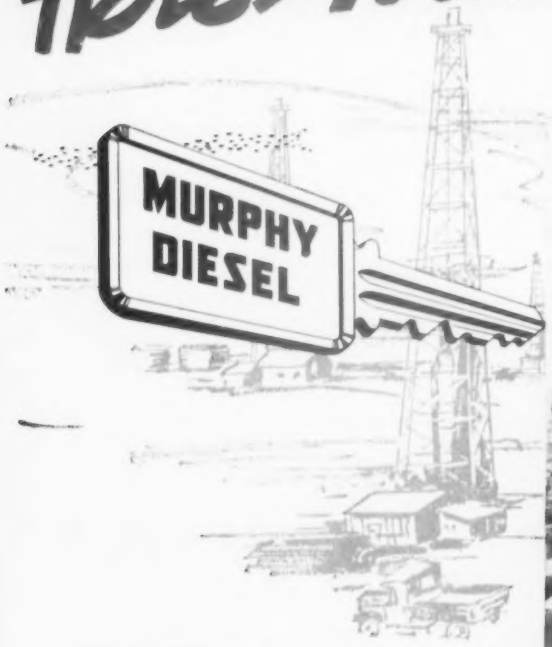
Operators who have been using it report getting 20 to 50% greater recovery of liquid hydrocarbons than was possible with conventional two-stage separation. Glycol Injection will produce 30 dew point depression below separator temperature, and greatly extends the benefits of conventional low temperature separation.

With a BS&B Glycol Injection System the wellstream can be cooled below its hydrate formation temperature before expansion. Therefore, effective low temperature separation with a pressure drop as low as 400 p.s.i. is possible. This means that as your wells become older, and available pressure drops decrease, they can still be profitable producers.

It also means that the gas delivered from your BS&B Glycol Injection System will conform to normal gas pipeline specifications, (not to exceed 7 lbs. of water per 1 MM SCF), without further dehydration.

BS&B's Glycol Injection System with Stabilizer operates at considerably lower temperatures than other comparable units. Profit-wise operators know that the lower the temperature at which separation occurs, the greater will be the liquid recovery. If you're not already a user, better call in your BS&B Man. There's one near you if you're in the Oil Country . . . or write for detailed information.

Here's Your Key to bigger drilling profits



National 50 drawworks powered by two Murphy Diesels each rated at 190 H.P., continuous, 210 H.P. intermittent. It is owned by Hulme Drilling Co., Great Bend, Kans. and is shown here near Hutchinson, Kans.

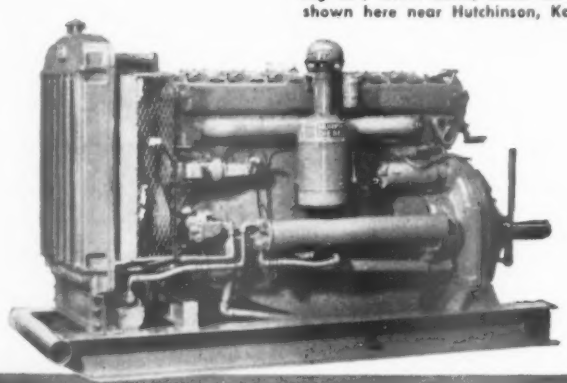
THERE are a lot of factors that determine how much profit you'll get out of any drilling operation, but they all depend on power. Without good, reliable power, the best equipment and the best drilling "know-how" can be wasted.

You can put an end to the power problem with Murphy Diesel power. Murphy Diesels deliver more usable heavy duty drilling power at a lower cost per horse power hour than any other engine of comparable size. Their proved record of dependability and long life adds more to a rosy profit picture.

The reasons why Murphy Diesels are able to deliver more power, greater economy and dependability and longer life are given in the booklet *"10 Questions to Ask a Diesel Engine Salesman"*. Ask your Murphy Diesel Dealer for a copy or write:

MURPHY DIESEL COMPANY

5305 W. Burnham St. Milwaukee 14, Wisconsin
Tulsa Office—Sales, Parts and Service:
113-117 South Elwood Street, Tulsa, Oklahoma



MURPHY DIESEL

Heavy Duty Power **For The Oilfields**

Murphy Diesel Engines and Power Units for drilling and pipe line pumping, 90 to 226 H.P., 1200 and 1400 RPM. Generator Sets, 60 to 140 K.W. Dual-Fuel Engines, 135 to 180 H.P. Also Crude Oil Burning Engines.

Sales Parts and Service: Tulsa, Oklahoma; Bakersfield and Los Angeles, California; Denver, Colorado; Great Bend, Kansas; Butte and Great Falls, Montana; Albuquerque, New Mexico; Corpus Christi, Dallas, Houston, Lubbock and San Antonio, Texas; Jackson, Mich.; and Edmonton, Alberta, Canada.

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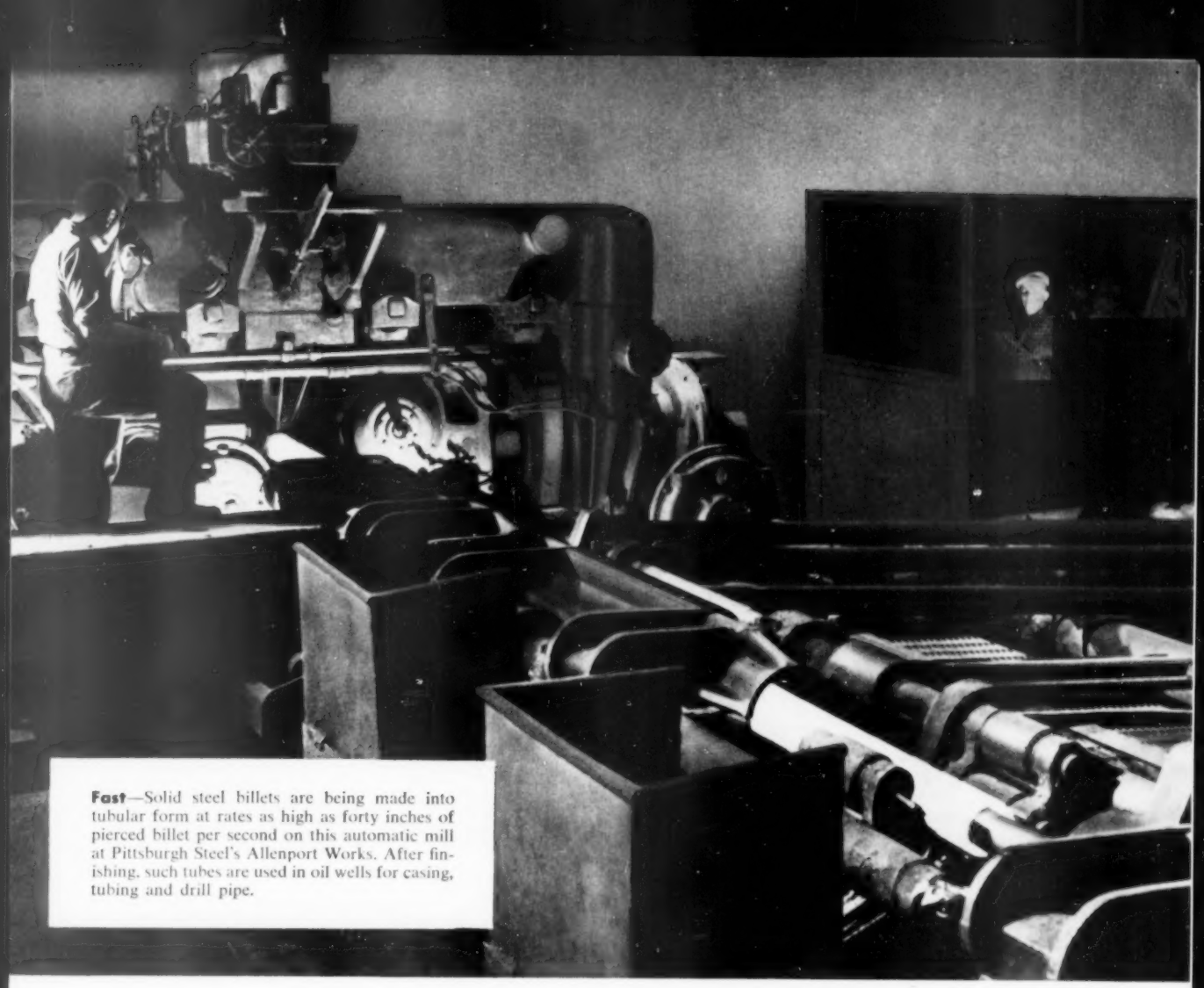


Fast—Solid steel billets are being made into tubular form at rates as high as forty inches of pierced billet per second on this automatic mill at Pittsburgh Steel's Allenport Works. After finishing, such tubes are used in oil wells for casing, tubing and drill pipe.

Progress in Steel . . . *Serves the oil industry*

As men probe deeper and deeper into the earth to recover petroleum, they depend upon quality tubing, casing and drill pipe such as is made by Pittsburgh Steel to enable them to drill faster, deeper, with greater safety than ever before. The confidence placed in these important products is well placed, for Pittsburgh Steel has pioneered for more than half a century in developing and improving oil country tubular goods.

In addition to this modern, automatic seamless rolling mill—one of the newest and fastest in the country—Pittsburgh Steel has just completed a $2-million casing finishing department. It can process enough seamless casing every eight hours to line two 12,000-feet deep wells. This department represents an important part of the Program of Progress which has transformed Pittsburgh Steel into a new steel company. Other details of this $62-million expansion and modernization plan are shown below.

Within a few months this Program of Progress will be 100% complete. Steel making capacity will be increased 48%—finished product capacity will be increased 82%. Customers will benefit by having a dependable source of supply for a wide range of products. Earning potential is being increased to benefit stockholders. Greater opportunities for advancement are being presented to employees—our civilian and defense economy is being strengthened—all because a new steel company has been created by three years of planned development.

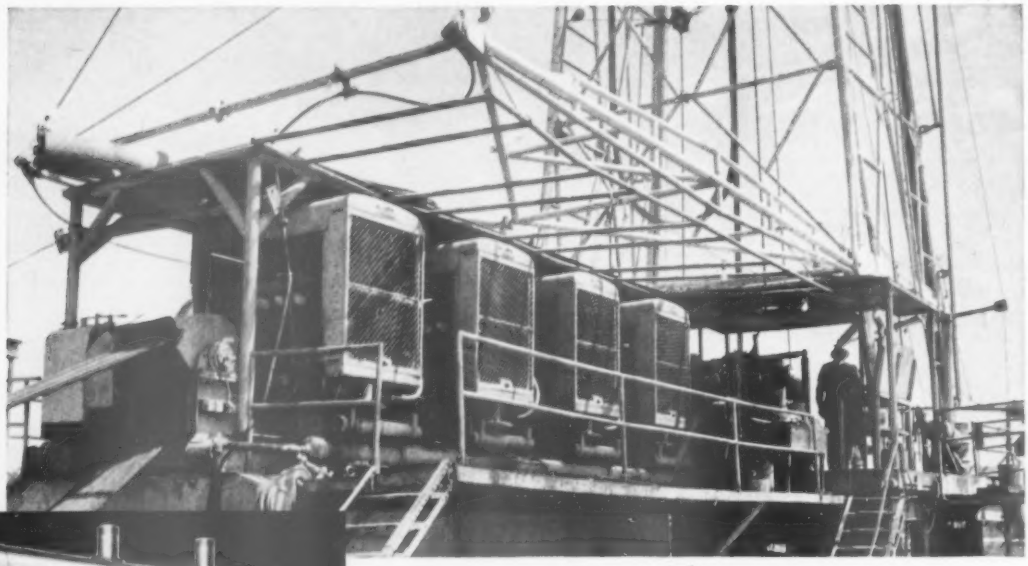
Program of Progress

Acquisition of Thomas Steel	**100%** Complete
Increase of Blast Furnace Capacity by 12%	75% Complete
Increase of Open Hearth Capacity by 48%	74% Complete
Installation of new 66-inch High Lift Blooming-Slabbing Mill	**100%** Complete
Installation of Continuous 66-inch Hot Rolled Sheet-Strip Mill	94% Complete
Installation of 66-inch Cold Rolled Sheet-Strip Mill	80% Complete

Pittsburgh Steel Company

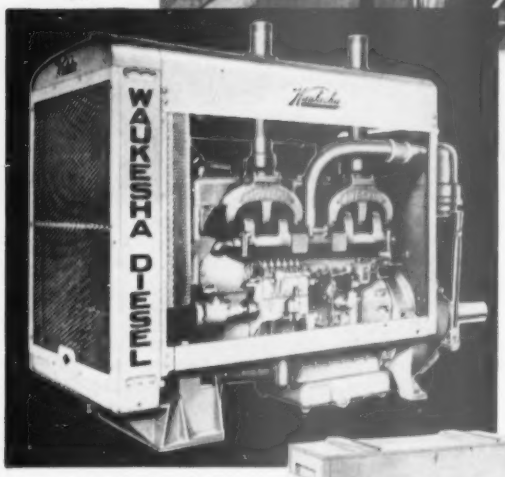
Pittsburgh 30, Pennsylvania

this rig has drilled 195,500 FEET...



Brewster N-10 Rig owned by Crow Drilling Co. of Shreveport, La.

211



6-WAKD WAUKESHA Diesel Unit, 6-cylinders, 6¼-in. x 6½-in., 1197 cu. in. displacement.

•

WAKD Conversion Kits contain special cylinder heads for gas fuel, top cylinder oilers, a complete gas fuel system, complete ignition system, and accessories. Write for details.

with

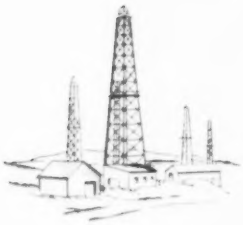
WAUKESHA *Diesel-Gas* CONVERSION UNITS

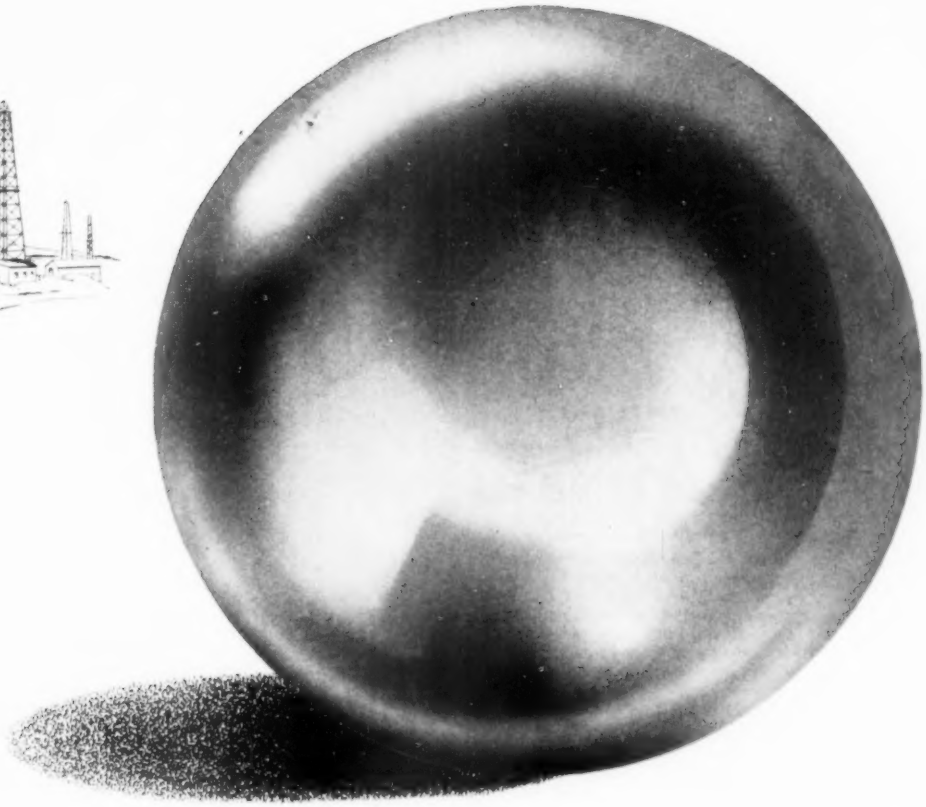
Conversion Kits are available for the three biggest Waukesha *Diesel* Oil Field Power Units—Models 6-WAKDU (1197 cu. in.), 6-NKDU (1905 cu. in.), and 6-LRDU (2894 cu. in.). In the oil fields of the world, Waukesha is a by-word for dependable full-rated gas or Diesel power. The Waukesha Conversion Kit gives the advantages of two real oil field engines in one. All the features which contribute to ruggedness and long life of the Waukesha Diesel are unchanged, but the converted engine is a true gas engine with special features that contribute to power and efficiency where gas is the economical fuel. Send for Bulletins or call your Waukesha Oil Field Distributor.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS., NEW YORK • TULSA • LOS ANGELES

WAUKESHA

Diesel — OIL FIELD POWER — Gas





NEW light-weight titanium-carbide* ball

Kennametal Titanium-Carbide Balls are 1/3 lighter than alloy steel, resist shock and wear over 20 times longer.

Used in sub-surface check valves, their remarkable lightness minimizes down-the-hole trouble caused by ball flutter, cage wear, and fluid pounding.

Diamond-like hardness of Kennametal Titanium-Carbide Balls increases valving efficiency in pumping flour sand cut fluids and other abrasive mixtures. Sphericity is maintained in conditions of severe impact, ball spin wear, and cage beating.

Titanium carbide and nickel content of Kennametal Light-weight Balls assures high resistance to corrosion and electrolytic action. They provide unexcelled performance in sour crudes and hydrogen sulfide gases.

•

You can obtain Kennametal Light-weight Titanium-Carbide Balls from your regular supplier.

*Called Kentanium

KENNAMETAL®

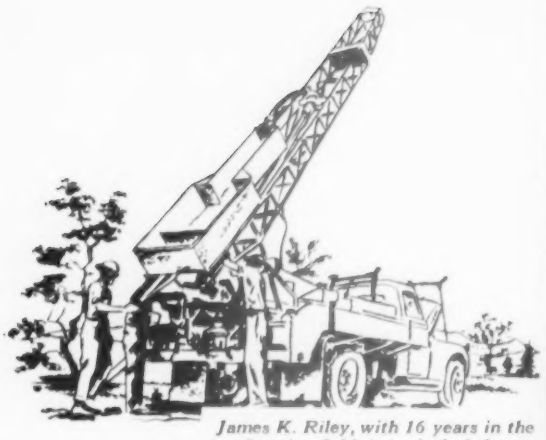
PUTS AN END TO DOWN-THE-HOLE CHECK VALVE TROUBLE

Quality Sintered Carbide API Balls and Seats

Manufactured by

Kennametal Inc., Latrobe, Pa.

SOLD BY YOUR REGULAR SUPPLIER



James K. Riley, with 16 years in the exploration field, is typical of the experienced party chiefs at IX. With Independent for 12 years, he has developed the knowledge necessary for obtaining profitable results.

Independent's "MEN WITH RESPONSIBILITY"

Average 16 Years Experience

The success of your geophysical surveys depends largely upon the experience of the Party Chief. Independent's Party Chiefs have an average of 16 years experience in the exploration field. This experience helps you to realize more profits from your geophysical surveys.

Since 1932 Independent has been making successful surveys in 26 states and foreign countries. One of the oldest exploration contractors in the business, Independent has served more than 100 important oil producers.

POINTING THE WAY IXC FOR THE DRILL

Independent's Experience Merits Your Confidence

Independent *Geophysical Surveys*

EXPLORATION COMPANY

1973 WEST GRAY ★ HOUSTON, TEXAS

ESTABLISHED 1932

Another new Armour chemical provides protection for water flooding operations

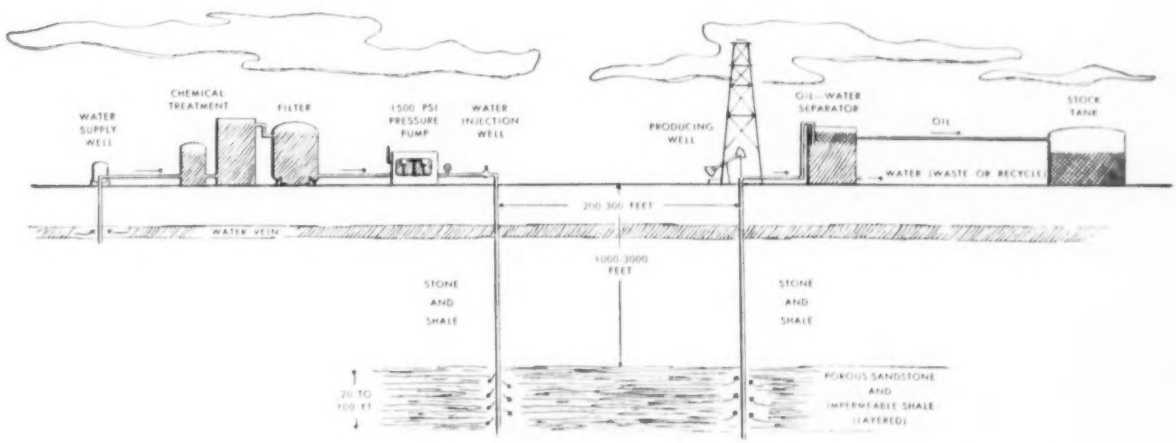
Arquad® T-2C is now available commercially for use as a corrosion inhibitor, bactericide and algaecide

The Armour Chemical Division, responsible for the development of many new chemicals for applications in the petroleum industry, has produced another corrosion inhibitor-bactericide, Arquad T-2C. This new member of the Arquad family (quaternary ammonium chlorides) provides corrosion inhibition and is extremely effective as a bacteria-controlling agent against the particularly troublesome sulphate reducing bacteria. Inhibition of the growth of this organism has been obtained at 6 to 7 ppm!

Important, too, in considering Arquad T-2C is its low cost. It is one of the most effective, and economical, corrosion inhibitors available to the industry! For free samples for testing in your own laboratories or in the field, check and mail the coupon today! And remember that our research and development laboratory is equipped and ready to help solve customers' problems.

Samples and further information

Arquad T-2C—and Armour's other effective quaternary ammonium chlorides—are described in our bulletin, "Arquads." For your free copy of this booklet, as well as a sample of Arquad T-2C, simply fill in and mail the coupon with your letterhead.



Mail this coupon with your letterhead

Please send me:

☐ Arquad T-2C sample ☐ Arquads booklet

Name _____ *Title* _____

Firm _____

Address _____

City _____ *Zone* _____ *State* _____

O

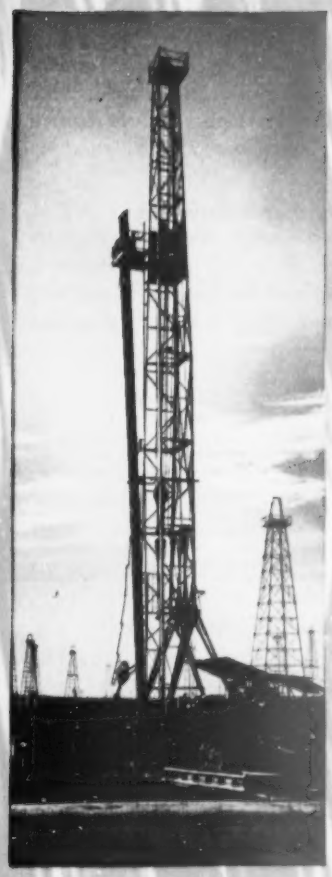
ARMOUR CHEMICAL DIVISION

©Armour and Company • 1355 W. 31st St. • Chicago 9, Ill.

"8½ Ton Mile per Foot...Best Service Record of Any Line"...with

STANDARD Tuffy Rotary Lines

Says Toolpusher for One of Oklahoma's Largest Oil Companies



SPECIAL CONSTRUCTION of Tuffy

Gives Better Rope Performance and Ton Mile Economy

". . . received 33,600 ton-mile with 4,000' Tuffy Standard Rotary Line, which figures 8-5/10 ton-mile per foot . . . best service record of any line purchased for this rig." (*name on request*)

Time after time, in field after field, Tuffy Standard Rotary Lines have proved their economy and better performance. How is this possible? Because Tuffy Rotary Lines are specially constructed of special steels to attain greater flexibility and higher resistance to abrasion, shock loads, drum crushing and internal friction. By using the planned cut-off procedure as shown in our handbook, "Wire Rope For Well Drilling," ton miles can be greatly increased.

Install Tuffy Standard Rotary Lines on your standard rigs, or on jackknife rigs used for deeper drilling. Compare the ton mile service and economy of Tuffy with any other lines you have used. You'll see why so many toolpushers and rig operators are switching to Tuffy Rotary Lines!

Tuffy Jackknife Rotary Lines

Specially designed . . . spools and reeves better on smaller sheaves and drums of the jackknife rigs. For deeper drilling with jackknife rigs, we recommend Tuffy *Standard* Rotary Line.

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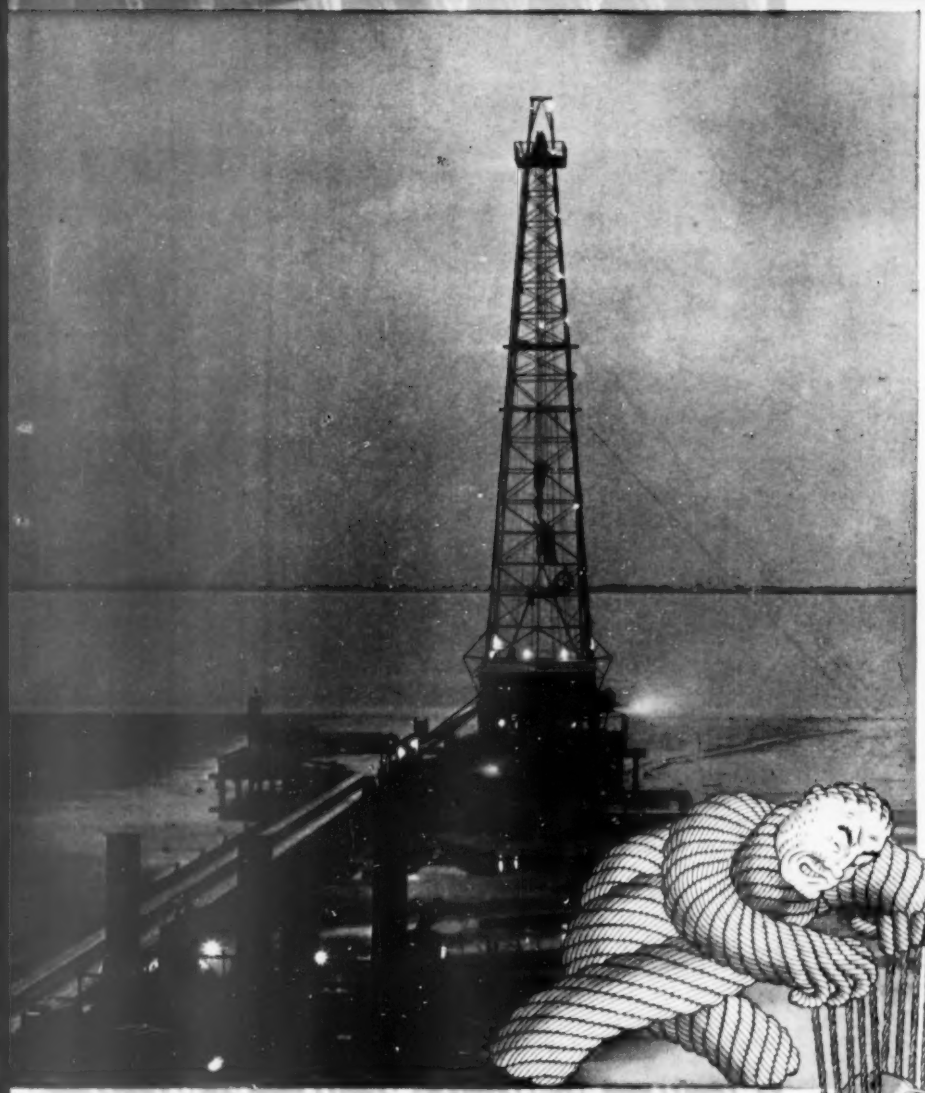
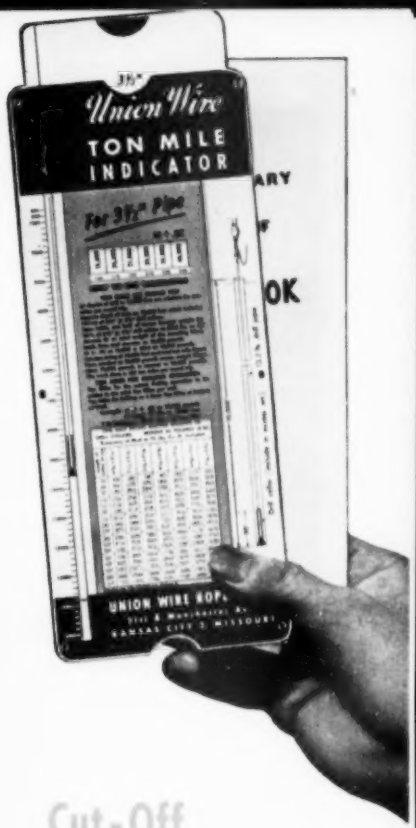
Specialists in Wire Rope and Braided Wire Fabric





Cut-Off Problems Simplified with this FREE TON MILE INDICATOR

Now it's easy to establish the correct cut-off time for each hole with this Union Wire Ton Mile Indicator. All you do is set the figures from your well log book and read the answer. All the complicated figuring is done automatically for you. By accurately measuring the work your line has done, you avoid wasting rope by cutting too soon or too frequently. Send for your FREE Union Wire Ton Mile Indicator and Log Book now. You'll find it can help you get many more ton miles of service and save money on wire rope.

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IT'S EASY TO ORDER!

Tuffy Rotary Lines

No complicated specifications to remember when you order Tuffy Rotary Lines. Just specify the length, size and Tuffy *Jackknife* or *Standard*.

New FREE Well-Drilling Handbook

JUST OFF THE PRESS!

"Handbook of Wire Rope for Well Drilling" contains latest oilfield information—more than 40 pages, complete with tables, charts, photographs to help you cut rope costs.

● Rotary Drilling ● Standard & Jackknife Rotary Lines ● Improving Ton Mile Service ● Cut-Off Procedures ● Servicing Drilled Wells ● Rigs & Ropes Used in Well Drilling ● Correct Handling, Field Care & Use of Wire Rope.

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1000 MILES AT A GLANCE

You are looking at the Platte Pipeline Company's communications system. 1000 Miles of super-efficient microwave, surveyed, designed, manufactured and installed by *Philco* . . . world's leading manufacturer of microwave equipment.

The entire 1000 miles of this new microwave communications and control system can be seen in a glance at this terminal control board in Kansas City, Missouri. All functions of the pipeline can be observed and controlled at this point . . . The operation of pumps and compressors, the pressures and flow rates of oil, telegraphic printers, VHF mobile and stationery radio, even the operation of the microwave system itself.

Philco microwave provides complete communications and control for this giant pipeline with greater reliability and less maintenance cost than could be obtained from any other type of system

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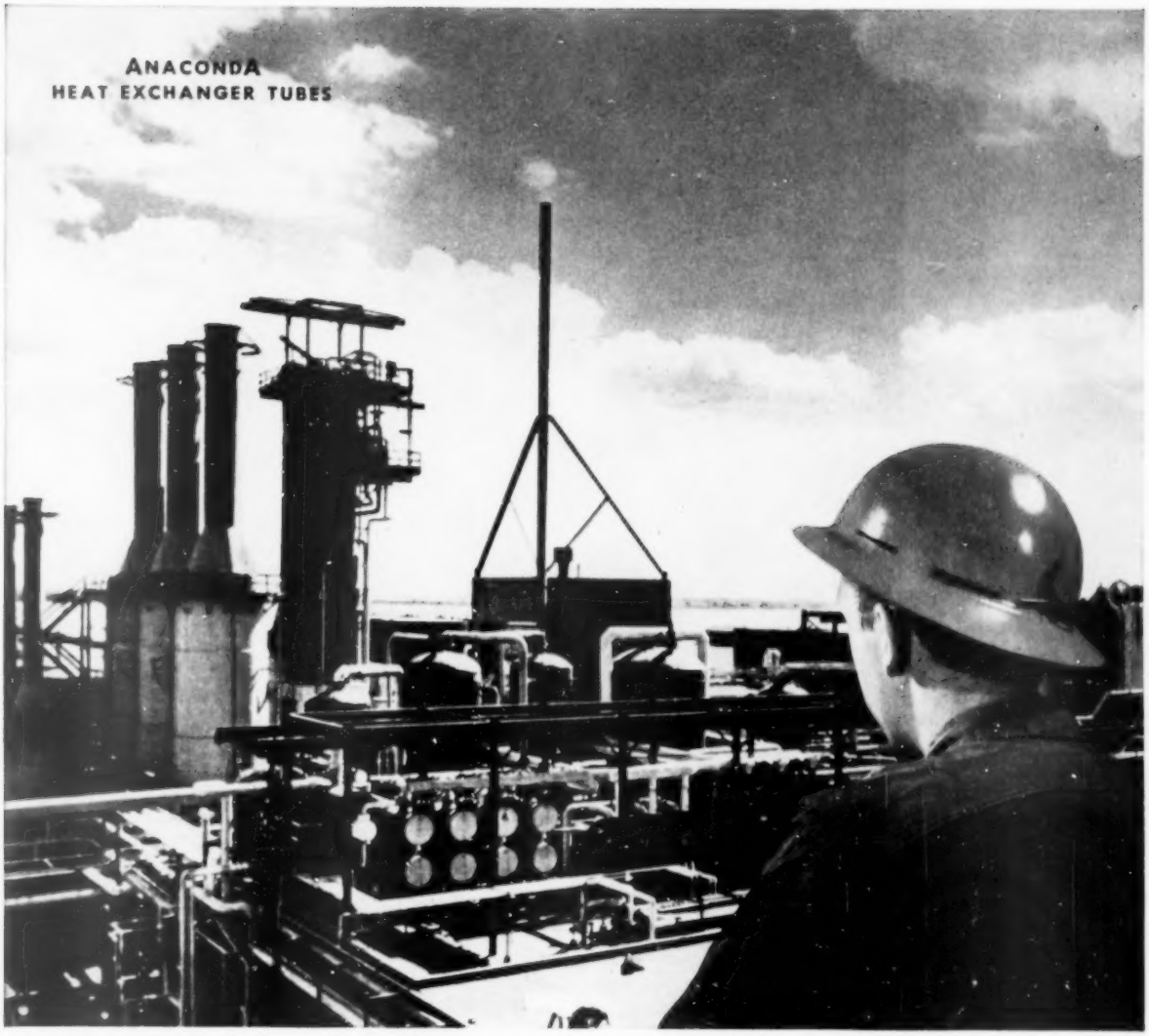

AMBRALOY-927: FOR DEFENSE AGAINST CORROSION BY SEA WATER AND IMPINGEMENT

Pass turbulently flowing sea water containing air bubbles through a heat exchanger and you have as vicious an enemy as ever attacked a tube. This combination meets its match, however, in Ambraloy-927,* arsenical aluminum brass.

Ambraloy-927 tubes specifically resist corrosion by both salt and brackish waters under many operating conditions by quickly forming a protective surface film. This film resists the impingement of turbulently flowing sea water containing air bubbles and abrasive solids. The presence of arsenic in the alloy gives Ambraloy-927 its high resistance to dezincification.

If your refinery is dependent on sea water for its coolant, you will find that this Ambraloy-927 puts up a stronger defense against these particular forms of corrosion than Admiralty alloys. Our Technical Department's experience is always available to you for selecting the tube alloy that best fits your operating conditions. Draw upon it freely. And use the coupon below for your copy of an informative Anaconda publication. 6111S

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Heat Exchanger Tubes

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The American Brass Company, Waterbury 20, Conn.
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are engineered to present day advances in power plant, chemical process, petroleum refining and industrial applications.

Superior Combustion Industries, Inc., designs, fabricates in their own plant, and guarantees the performance of heat exchangers for all applications . . . selecting proper details to match operating conditions of pressure, temperature, special materials or pressure drop limitations for every heating, cooling, evaporating or condensing operation.

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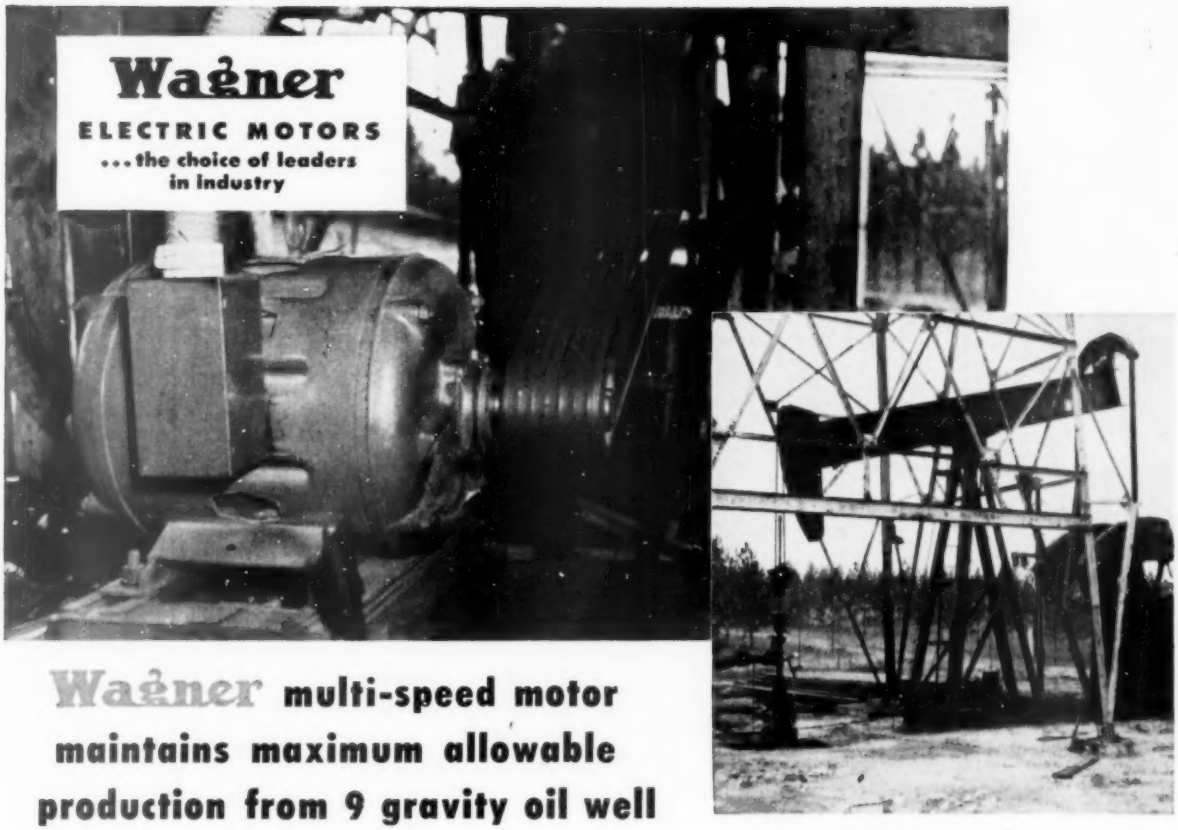


Wagner multi-speed motor maintains maximum allowable production from 9 gravity oil well

Obtaining allowable production of 232 barrels a day from this 7,200 foot oil well at Ovett, Mississippi, presents a real problem. The viscosity of the raw production is so great that warmed oil must be circulated in the near surface depths of the well to even enable it to flow. A butane engine on the rig was able to pump only 100 barrels a day.

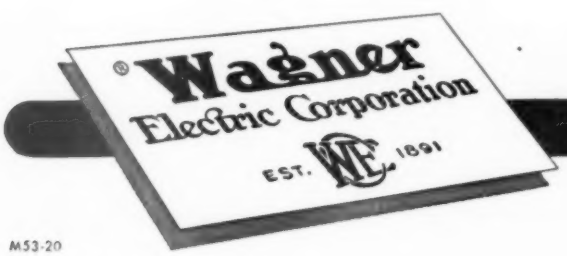
Then a Wagner four speed motor was installed on the rig. The motor starts pumping at 575 rpm. As the crude oil warms and becomes more pumpable the speed of the motor is increased to 870 and then to 1160 rpm. Allowable production can normally be reached by pumping at the third speed, but if it should fall behind, the fourth speed (1750 rpm) is available to bring production up to the maximum.

Wagner Multi-speed Motors are furnished with any type of housing—open drip-proof, totally-enclosed, explosion-proof, splash-proof, etc., and with various electrical characteristics such as normal torque, high torque, etc.

The loading pump on this installation, not shown, is driven by a 20 hp Wagner splash-proof motor.

For your requirements, there is a Wagner Motor to fit every need—a complete line for all current specifications, with a wide variety of enclosure types and mountings. Bulletin MU-137 gives full information. Do you have a copy?

Your nearby Wagner engineer will be glad to help you select the *right* motors for your next application. Call the nearest of our 32 branch offices, or write us.



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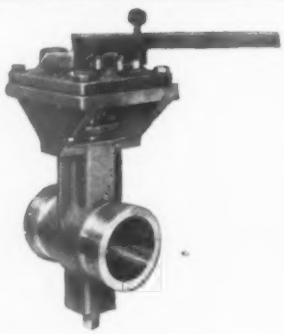
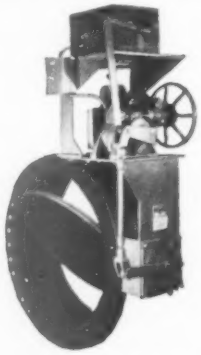
- for manual or any type of automatic control
- for any material that flows or is forced through a pipe
- in any material that can be cast or welded including plastics and certain alloys especially adapted to resist corrosion, erosion and temperature.
- in all sizes for all industries and processes, and in the temperature range from minus 300° to plus 2000° F. 2 to 2500 psig.

Representatives are listed in telephone directories as: "R-S Products Corporation Valves".



No. 674—Special 2½-inch stainless steel valve with 150 psi construction. Standard sanitary type threads. Heavy duty handlever assembly Type No. 681.

No. 848—Heavy duty valve with rubber seat for water service at high velocity. Handwheel operates valve through spur gear and pinion into a threaded reach rod (enclosed Type No. 700) in order to obtain sufficient torque to seat disc in rubber.



No. 847—Heavy duty valve with electric motor operator mounted directly above valve and positioned by pressure controller mounted above the motor.

Consult your local R-S Valve Engineers, or write direct.

R-S PRODUCTS CORPORATION • 4600 Germantown Ave., Philadelphia 44, Pa.

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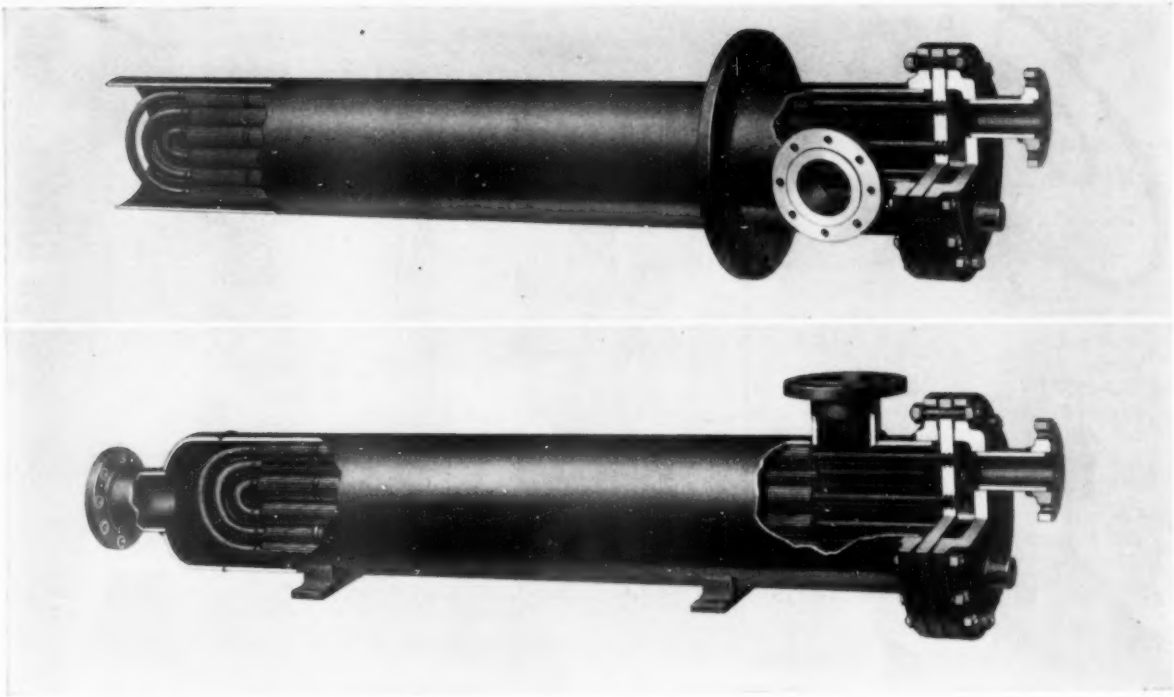


BROWN FINTUBE

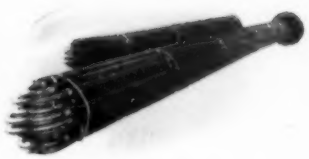
Tank Suction Heaters and Line Heaters

Offer Many Outstanding Advantages

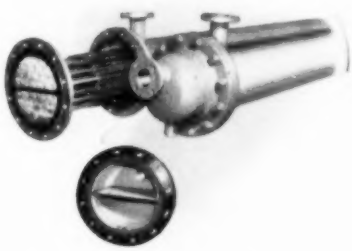
Brown welded fintubes provide much greater heating surface per foot of length than plain bare pipe or tubing. Consequently these heaters transfer more heat — at lower temperatures — assuring **faster, more efficient** heating without damaging the material or causing coking and build-up on the heating surface.

Metal bands placed around alternate fintubes in the bundle prevent the tubes from interlocking. This eliminates baffles and tube spacers that create back eddies and stagnant areas that encourage fouling;—and permits the fluid to travel through the longitudinal passages of the fintubes in close contact with the fins and center tubes — at low pressure drop.

Tank Suction Heaters that mount on a tank nozzle or the tank shell — also Line Heaters for pressure or suction service. Sizes 5″ to 24″ in diameter and 4′ to 24′ in length. Send for Bulletin No. 521. It gives full details.



Brown Fintube Hairpin Bundles Showing the Banding of Alternate Tubes that Eliminates Baffles and Assures Unobstructed Flow.

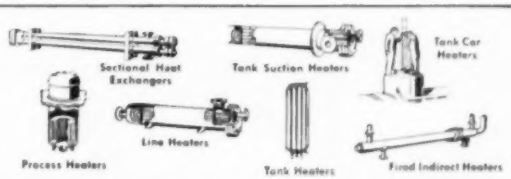


Hairpin Bundle Assembled in Shell Showing Mounting of Tube Sheet Between the Shell and Head.

BROWN FINTUBE

BROWN FINTUBE CO.

Elyria, Ohio



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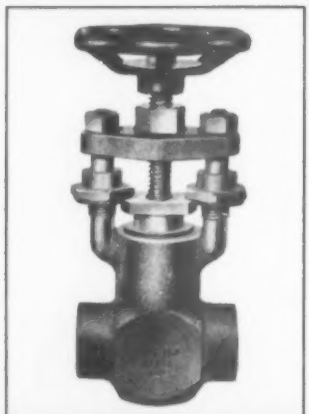

NO BONNET JOINT DESIGN

BOLTED BONNET DESIGN

800# GENERAL PURPOSE
HANCOCK STEEL GATE WELDVALVES

Extra years of trouble-free dependability. Long-life economy. 800# Hancock Steel Gate Weldvalves give you both. Select either "no bonnet joint" or bolted bonnet design — incorporated in them are exclusive construction and operational features that have proved their value in the severest services. Yet they cost no more than ordinary valves.

Among the many superiorities built into these valves are:

1. Maximum use of super-strong, leak-proof welding.

2. Integral Stellite seats.

3. "500 Brinell" stainless steel wedges.

4. No galling because dissimilar materials are used for the accurately finished and perfectly aligned seats and wedges.

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6. Corrosion-resisting back seating.

7. Extra-strong upper structure.

8. Repacking ease.

9. Safe, comfortable handwheel — designed to operator specifications.

10. Complete interchangeability of parts that saves time, trouble, money.

11. Baked enamel exterior finish for maximum protection.

SIZES: *No Bonnet Joint Design*—¼" through 2". *Bolted Bonnet Design*—1¼" through 2".

CONNECTIONS: Screwed ends . . . socket weld ends . . . flanged ends.

SERVICE RATINGS: For *all* pressures up to 800 psi at 750° F.—O.W.G. 2000# 100° F.

Hancock Steel Gate Weldvalves do a job and stay on the job. Complete information about the type you like best is available through your Hancock Valve Distributor. Get in touch with him today.

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"I wanted V-Belts loaded with guts... and I sure got 'em in U. S. Rainbow®!"

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"I know what I'm talking about," says this hard-driving toolpusher. "Latest case I know is a Texas contractor* who put Rainbow V-Belts on a compound drive. So far he's used them 43 months and has drilled over 218,970 feet of hole, moving from location to location. The brand of belts used *before that* failed after three wells. You can see why Rainbow's for me. That goes for anything in the "U.S." oil field specialty line—like, for instance, U.S. Royal 4 Rotary Hose."

Every U.S. Rainbow V-Belt has the unique Equa-Tensil Cord Section — the United States Rubber Company development that enables each cord to pull its full share of the load—for *extra* power. Rely on "U.S." to give you *quality* and help you in the fight against downtime.

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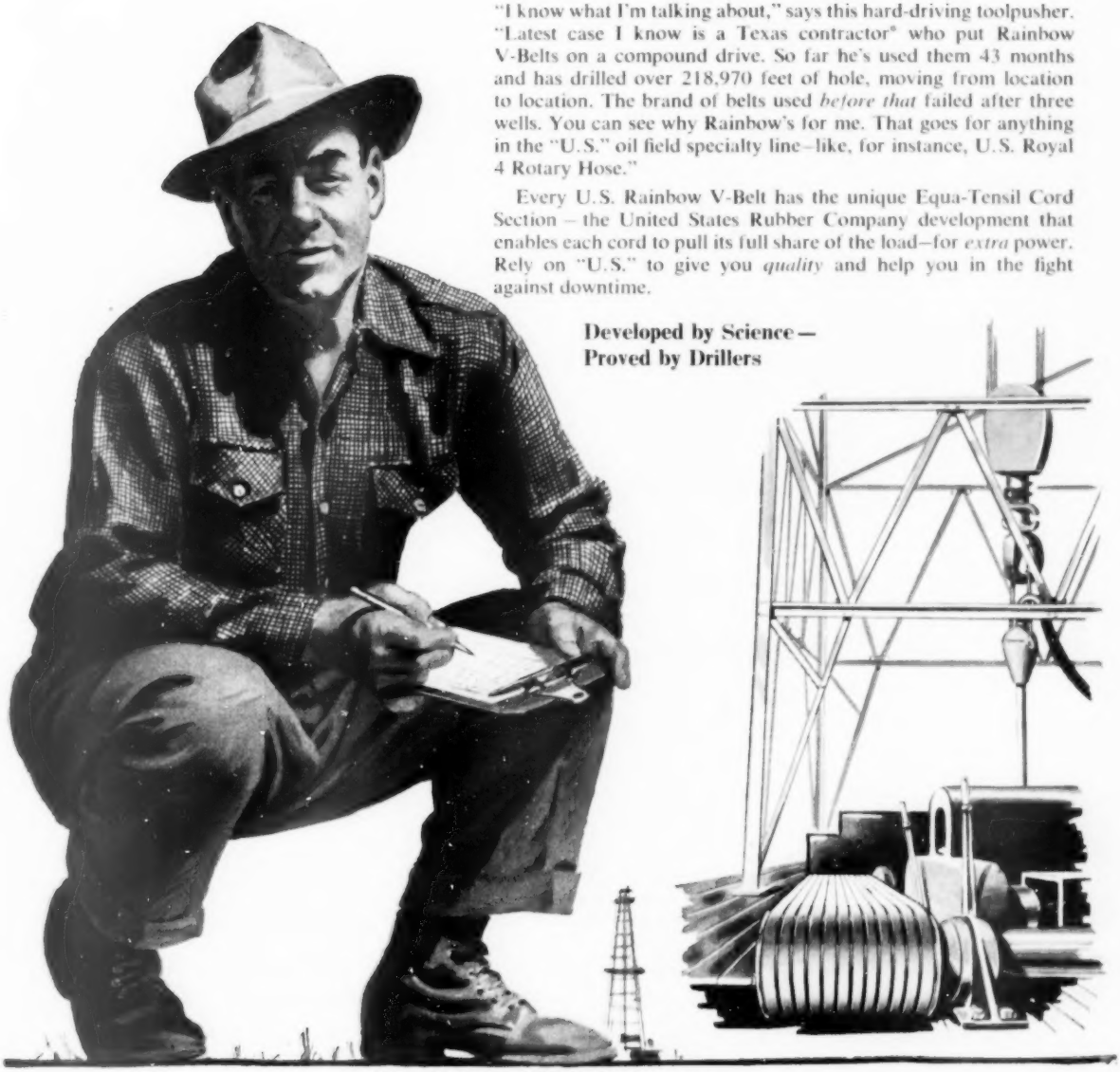

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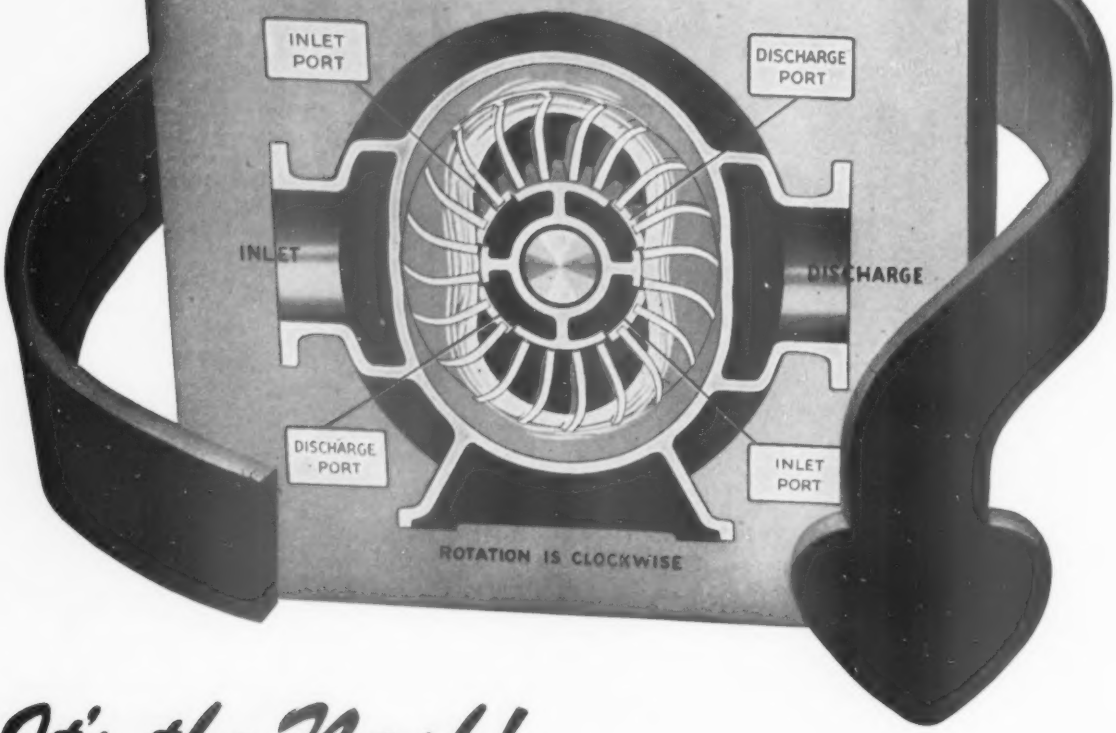
This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

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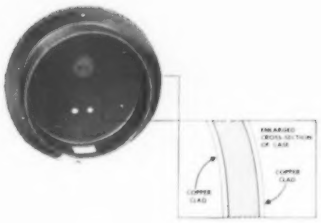

Another first for Marsh

Here is a case in keeping with the "Conoweld" tube. Another recent Marsh development, it is called the

New *Marshalloy* Case

It is a copper-clad wrought steel case of boiler plate thickness, four times as strong, and one-third lighter than conventional cast iron cases. Copper surface makes it as non-corrosive as a plastic or die-cast case. Handsome, corrosion-resistant, satin black enamel and Marsh safety blow-out plug are the finishing touches.

Here is one of those typically MARSH developments . . . the kind of pioneering step you have come to expect from the organization that originated the basic advances in pressure gauges culminating in the exclusive "Recalibrator." This latest Marsh development is known as the

NEW MARSH *"Conoweld"* TUBE

This time we have made the best part of the best Marsh gauge still better. We have gone into the part that actually does the work — the socket and tube — and have made it permanently leak-tight from inlet to tip of tube.

We have done this by fusing the tube into the socket and the tip to the tube so that the whole assembly is truly *one piece*. The photo of one of the sockets sawed in half shows the perfect fusion of the vital joint. Tests and photomicrographs prove the perfection of the fusion.

Developing the fusing process called for extensive research. The method as finally perfected — the "Conoweld" process — involves first fusing the tube to the socket and end-piece; then tempering the tube to required resiliency.

Yes, it is these dramatic departures from beaten paths that have achieved leadership for Marsh gauges and are ever increasing that leadership. Ask for latest information covering gauges for all services.

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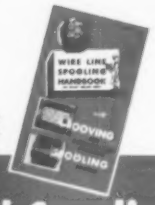
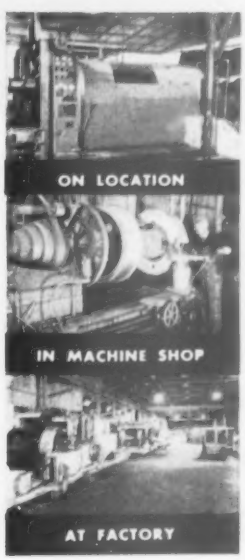
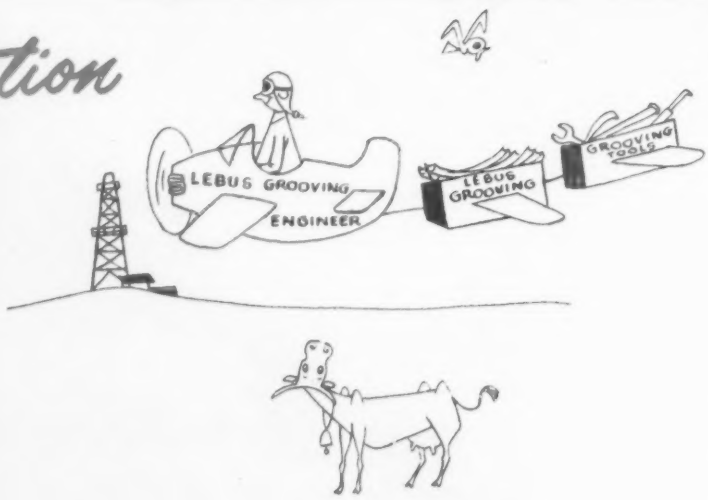
PAGES FROM THE LEBUS WIRE LINE SPOOLING HANDBOOK



LeBus Grooving and Controlled Pyramid Spooling*

Installation





LeBus Engineers have designed their grooving and spooling system to fit any drilling rig on the market today and through their installation procedure are able to install the system within a minimum amount of time. They can make this grooving installation without dismantling the hoisting unit on location where the drilling rig is operating, in the drilling contractor's yard, in the machine shop, or in the factory where the drum can be grooved before being installed in the drawworks frame.

LeBus has kept pace with the changing demands imposed by steadily increasing depths, new drilling methods, and the ever-changing types of drilling equipment. Constant study of the requirements of the equipment on which the LeBus Grooving System is installed, coupled with the close control of quality of the grooving while it is being manufactured, assures the operator the finest grooving and spooling service obtainable with the greatest efficiency and economy.

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The field for this unique steel-working process developed by Cameron is unlimited—breech rings for heavy artillery—general industrial equipment—refining—wherever stresses are likely to cause mechanical failure.

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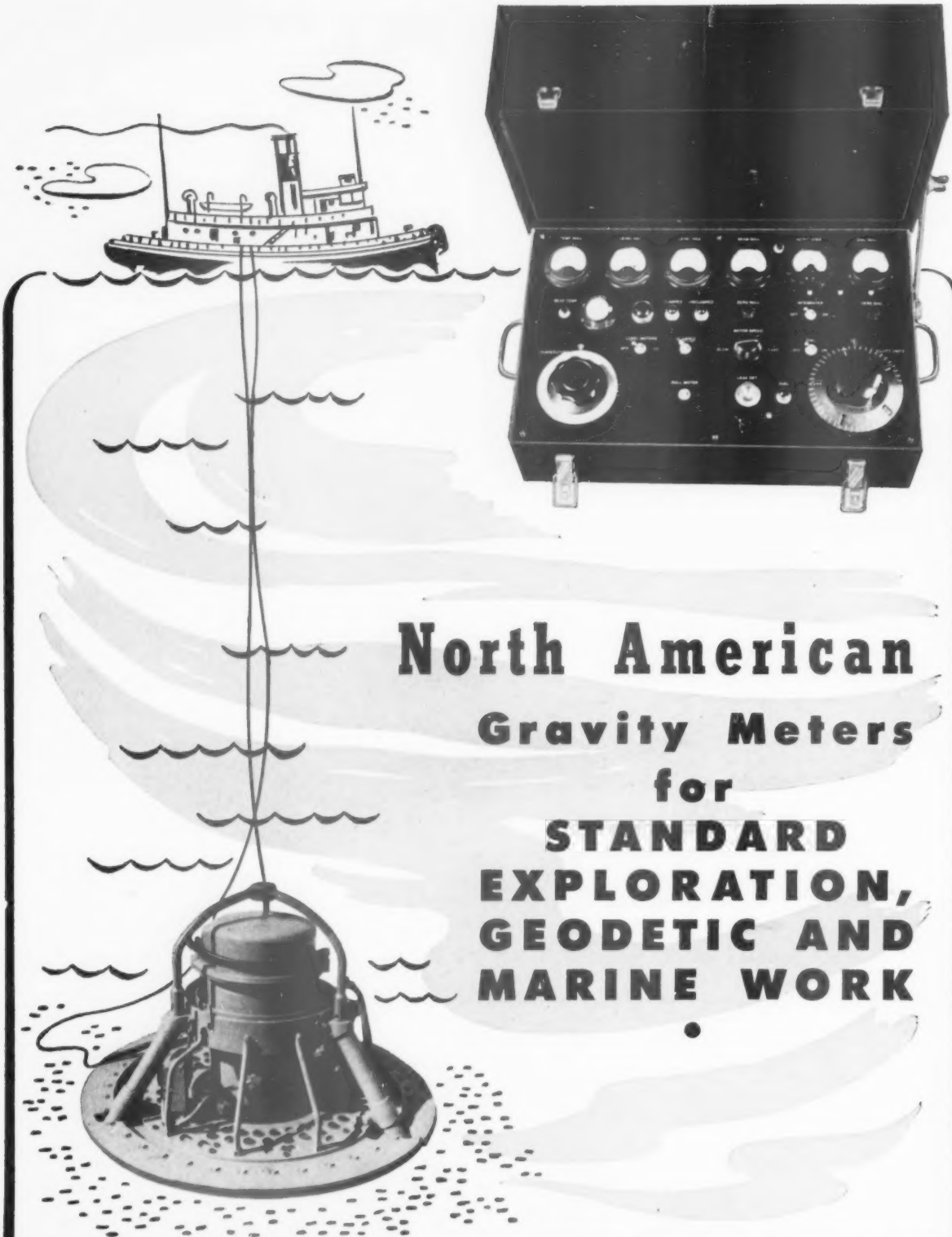

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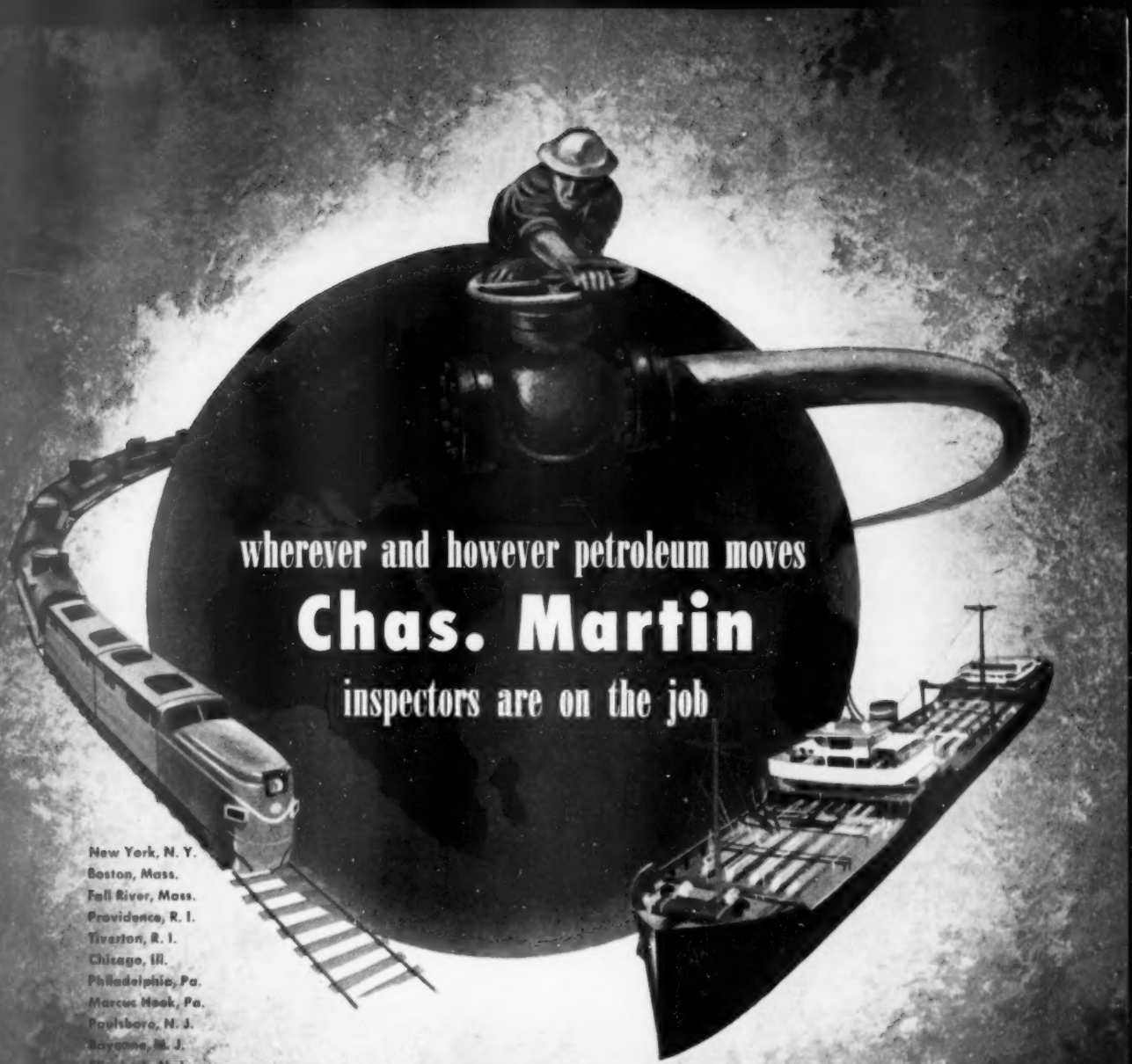

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inspectors are on the job

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Texas City, Texas
Freeport, Texas
Corpus Christi, Texas
Brownsville, Texas
Helena, Ark.
Arkansas City, Ark.
San Pedro, Calif.
San Luis Obispo, Calif.
San Francisco, Calif.
Seattle, Wash.
Las Piedras, Venezuela
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TANK CALIBRATION SPECIALISTS

Chas. MARTIN & Company

INSPECTORS OF PETROLEUM

World's First Petroleum Inspectors

Graphic control . . . *for leading industries*

The well-established trend to centralized graphic instrumentation has brought with it many specific advantages to the operation of complex, modern processing units. And to realize most fully the potential advantages of improved efficiency, simpler supervision and better coordination, many leading companies have turned to Honeywell graphic control.

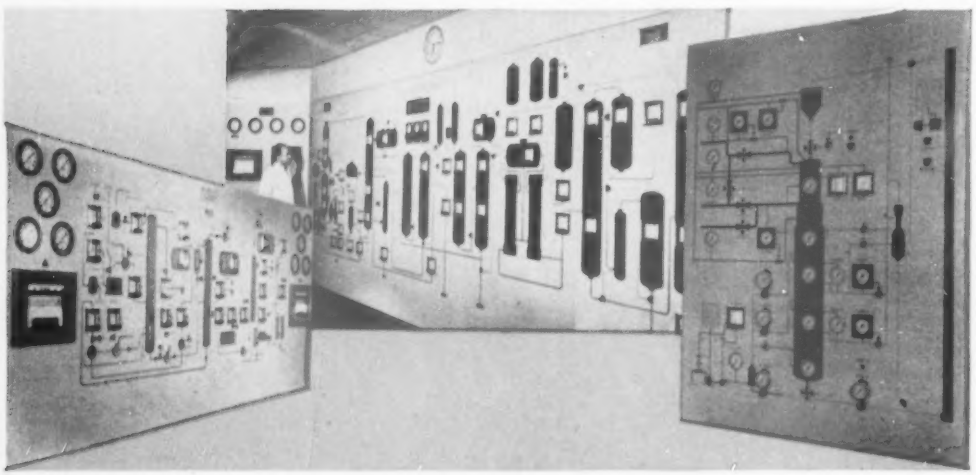
Among the engineering, construction and producing organizations which use Honeywell panels are some of the best-known names in their fields. The ever growing list includes:

C. F. Braun
Catalytic Construction Co.
The Fluor Corporation Ltd.
Foster Wheeler Corp.
Gulf Oil Corporation
Imperial Oil of Canada
M. W. Kellogg
The Lummus Co.
Pan-Am Southern
Phillips Petroleum Co.
The Refinery Engineering Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Standard Oil Co. of California
Standard Oil Co. of Indiana
Standard Oil Co. of New Jersey
The Texas Company
Tide Water Associated Oil Company
Union Oil Co. of California

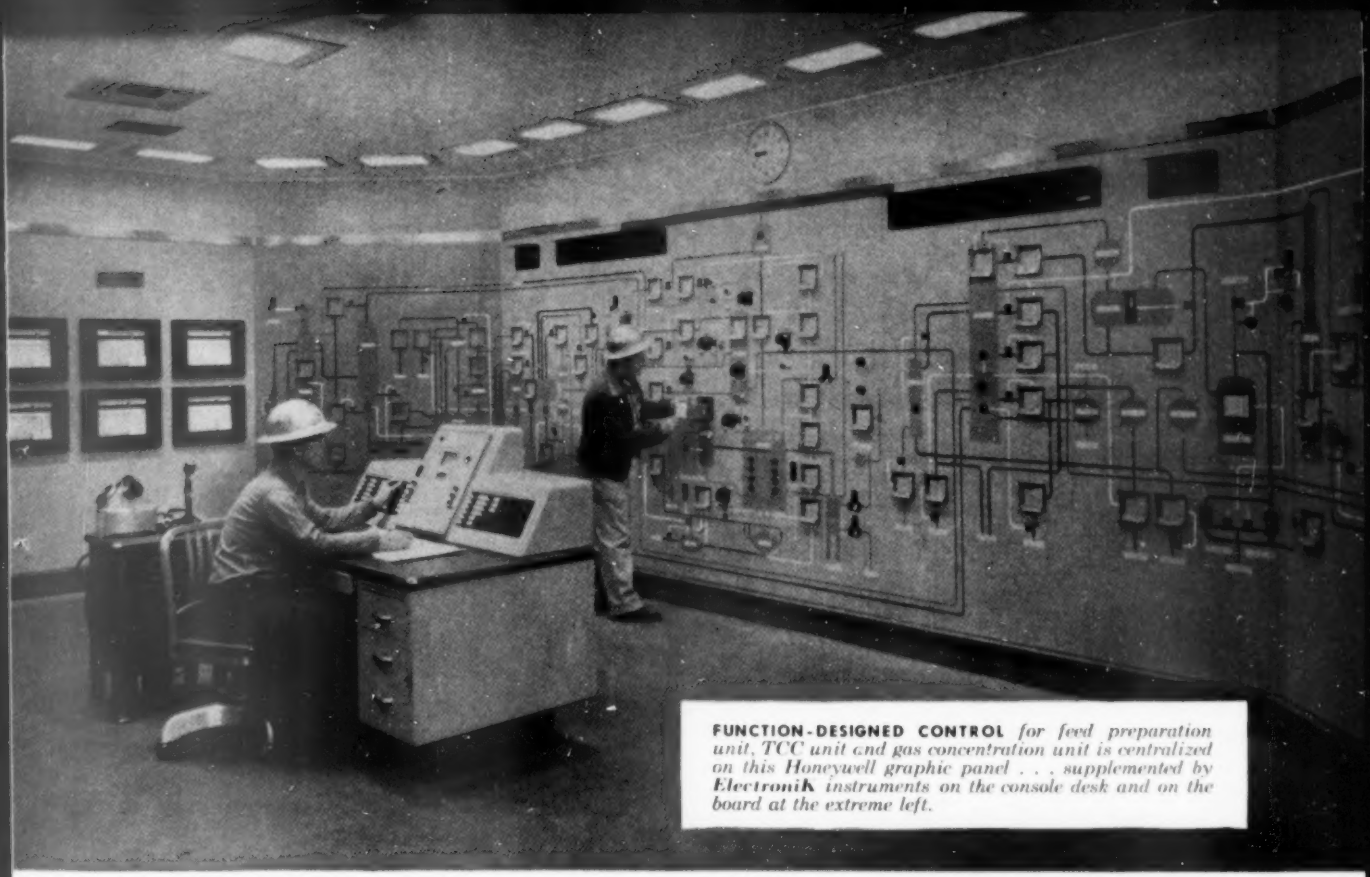
Reasons for acceptance

Behind this industry-wide acceptance stand several definite reasons. First is system engineering . . . by graphic panel specialists who translate process requirements into an integrated, harmonious design. Second is instrumentation . . . including a full line of *Tel-O-Set* miniature indicators, recorders and controllers, and *ElectroniK* instruments for supplementary recording, which enable Honeywell to satisfy the requirements of every phase of process control. And third is workmanship . . . skilled assembly in a manufacturing department devoted exclusively to this work.

Honeywell *operation*



FUNCTIONAL DESIGN *for maximum efficiency is the keynote of Honeywell graphic instrumentation. These typical panels show a few of the varied types which have been built for varied process applications.*



FUNCTION-DESIGNED CONTROL *for feed preparation unit, TCC unit and gas concentration unit is centralized on this Honeywell graphic panel . . . supplemented by* ***ElectroniK*** *instruments on the console desk and on the board at the extreme left.*

graphic control *simplifies of* new Phillips TCC unit

PHILLIPS PETROLEUM'S new unit at Okmulgee, Oklahoma is an outstanding example of skilled application of modern design. It is the first air-lift thermofor catalytic cracker to be equipped with full graphic control . . . which Honeywell designed and built for this exacting application.

On a board 41 feet long and 7 feet high is concentrated complete control instrumentation for guiding the operation of the 8,000-barrel-per-day TCC unit, fired preheater, flash drum, vacuum still, and gas concentration unit. The variety of instrumentation illustrates the versatility of Honeywell graphic control. Included are *Tel-O-Set* Indicators and Recorders for critical flows, differential pressures, liquid levels and temperatures throughout the unit. Installed directly in the process diagram, these miniature instruments give operators accurate, conveniently-read facts on each variable.

Supplementing the graphic instrumentation is a group of multi-point *ElectroniK* instruments which provide detailed recording of vital temperatures, and a console-mounted *ElectroniK* Precision Indicator with which operators can spot-check additional temperature points.

Honeywell engineering combines all these elements into a harmonious, attractive design that affords maximum ease of operation . . . simplifies training of personnel . . . facilitates start-up and emergency process control.

Your local Honeywell engineering representative will be glad to discuss graphic control for your own processes. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4488 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Composite Catalog No. 5000 for a brief description of the complete Honeywell line.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

H HONEYWELL

Interchangeable

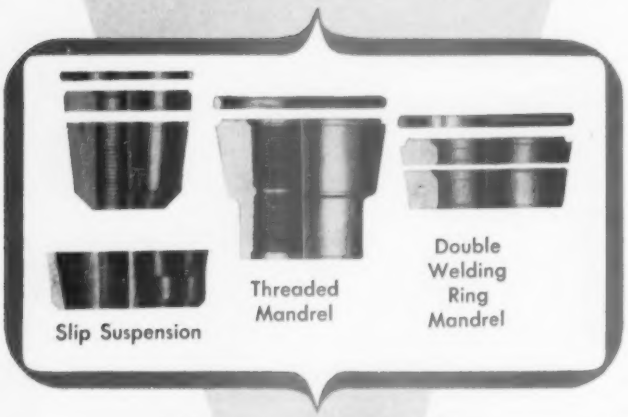
SLIP OR MANDREL SUSPENSION

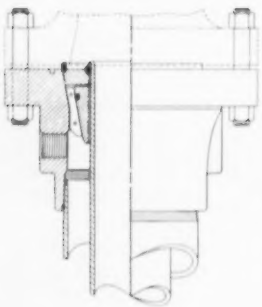
WITH

RECTORHEAD

TYPE "MS"

CASING HEAD





Assembly of Type MS Rectorhead Casing Head utilizing slips and slip bowl. Available only in three sizes: 10¾", 9⅝", and 8⅝", and in Series 600 and 900 only. Head is furnished complete with slips, slip bowl, single welding ring, bolts, nuts and API Ring Gasket. Heads are available with threaded or flanged side outlets.

This Rector Type MS Casing Head offers you slip suspension or the choice of two types of mandrel suspension . . . all of which utilize the famous Rector metal-to-metal seal.

In the 8⅝" size, especially designed slips fit directly into the head body. In the 9⅝" and 10¾" sizes, the slips ride in a special slip bowl. The metal-to-metal, leakproof seal is obtained by use of a single welding ring placed directly above the slips and welded to the casing. An API Ring Gasket at the juncture of the welding ring and head body completes the seal.

For mandrel suspension you have the choice of a threaded or double welded type. With either hanger an API Ring Gasket acts dually as the sealing medium and hold-down. These mandrel hangers are installed the same as in the Type M Rectorhead Casing Head which has a restricted ring groove to permit installation of a higher working pressure head without use of additional flanges. The Type MS Casing Head is similar in design but lighter in construction than our Type RH and is comparable in price and setting depth to our Type M Mandrel Hanger Casing Head.

Ask your nearest Rector Representative or authorized Supply Store about the Type MS Rectorhead Casing Head for your next well.

RECTOR

SEE OUR CATALOG IN THE COMPOSITE CATALOG

PESA

RECTOR WELL EQUIPMENT COMPANY INC

★ MAKING THE OIL INDUSTRY SAFER ★

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

1100 NORTH COMMERCE ST FORT WORTH, TEXAS

Houston Plant: 2215 Commerce St.

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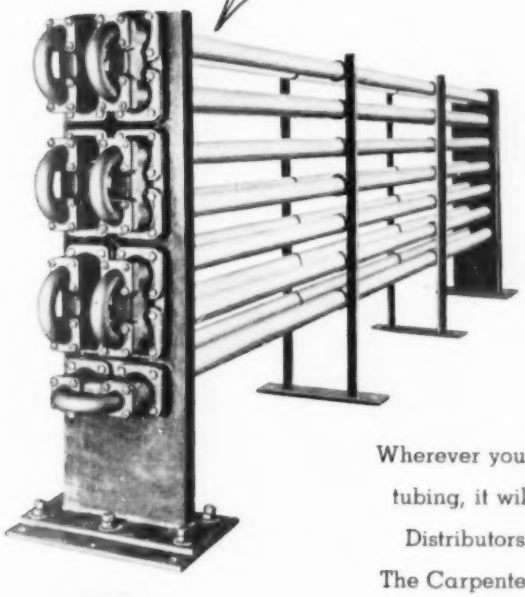
RECTORHEAD RECTOR DUPLEX CEMENTING METHOD RECTORSEAL

Carpenter Stainless Tubing KEEPS PROCESSES GOING ON SCHEDULE



Modern heat transfer equipment has to stay on the job. You can't afford to interrupt a process for hours or days to replace tubes.

That's why the manufacturer of these units selected Carpenter Stainless Tubing, Type 316. In addition to providing good corrosion resistance, Carpenter tube quality and uniformity help to make the 20th unit as good as the first.

Wherever your processing equipment involves corrosion-resistant tubing, it will pay to put Carpenter experience to work for you. Distributors are located in principal cities from coast to coast. The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y. "CARSTEELCO"

Send for this USEFUL SLIDE CHART

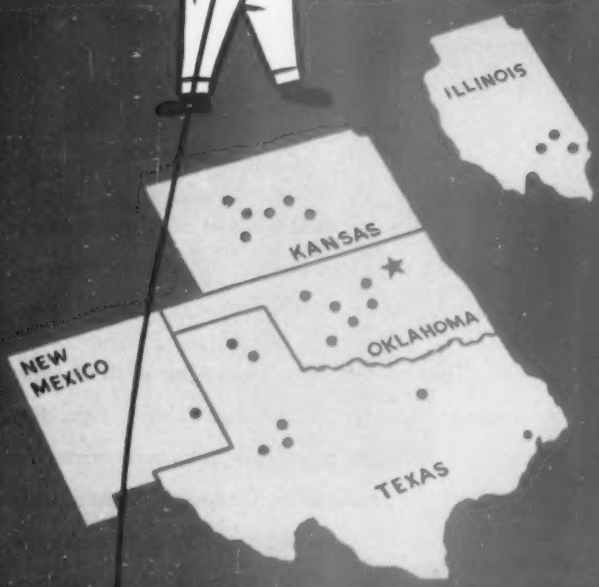
Physical properties, sizes and gauges, cross-sectional areas, velocity constants, pressures, weights and other technical data on Carpenter Stainless Tubing for heat exchanger applications are condensed into this handy chart. It's yours for the asking, on your company letterhead.

Carpenter

STAINLESS TUBING & PIPE

- guaranteed on every shipment

Just call Bovaird!



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WHERE you want it
WHEN you need it!

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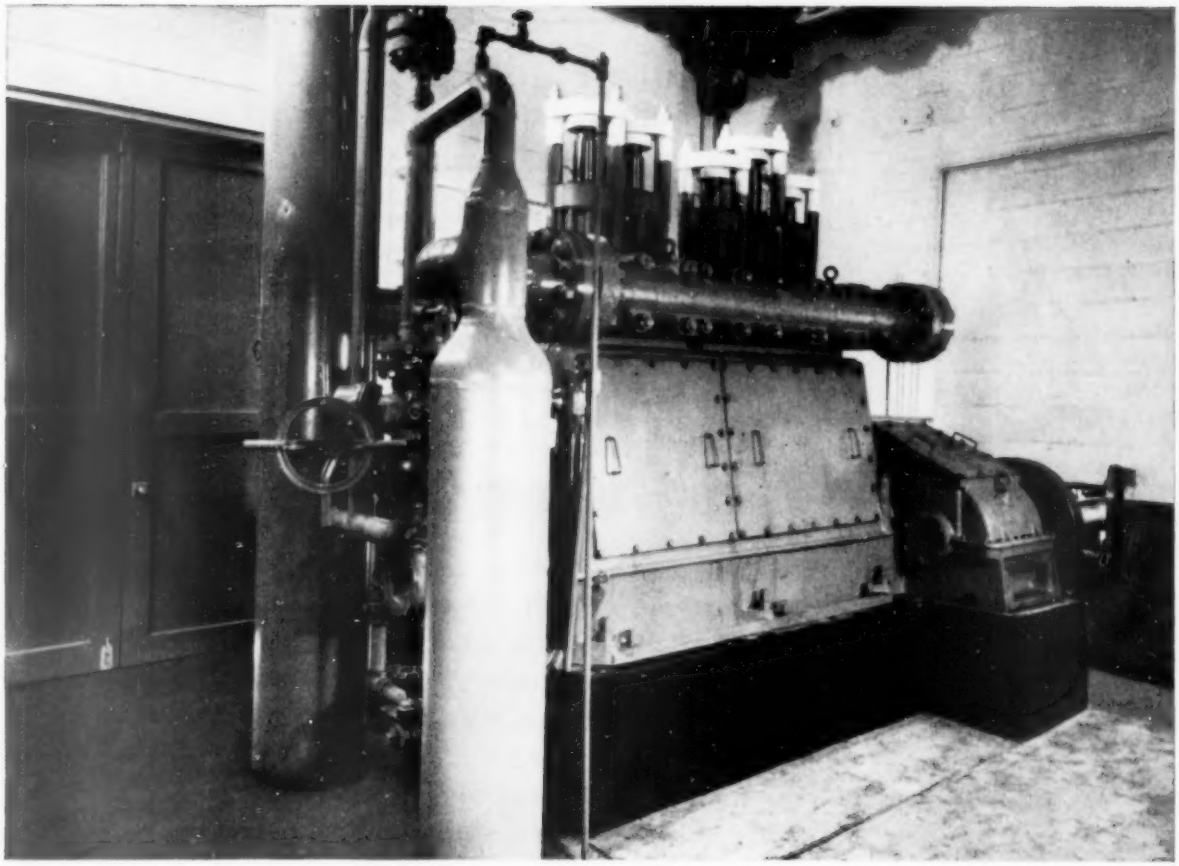
"Buy From Bovaird"

THE Bovaird SUPPLY COMPANY
GENERAL OFFICES
TULSA, OKLAHOMA

82 YEARS OF PROGRESS WITH THE OIL INDUSTRY



ALDRICH PUMPS Send Liquids Through Cross-Country Pipe Line

In service at the North Salt Lake Pumping Station of the Salt Lake Pipe Line Company, this Aldrich Quintuplex Inverted Direct Flow Pump and a twin unit are used to pump liquid products through an 8″ pipe line to Boise, Idaho, some 350 miles distant.

Fluids sent on their long distance journey by these Aldrich Pumps include regular and premium automotive gasolines, Diesel fuels, stove oils and alkyate. Pumps feed 375 gpm, against maximum discharge pressure of 1700 psi. Suction pressure averages 30 to 40 psi. Installed in December 1952, these pumps already have been in operation more than 2000 hours each.

This operating performance story is typical of Aldrich's record throughout the oil industry. In whatever way they're called upon to serve—whether water flooding, lean oil service, salt water disposal, crude and gathering lines, product lines, bottom hole pump service, or pumping liquid hydrocarbons—Aldrich Pumps set standards for dependable operation.

With Aldrich Pumps the user gets several marked construction advantages and benefits. For example, fluid ends are sectionalized, so that parts can be replaced quickly and at low cost. Plunger sizes are changeable, and wearing parts are interchangeable among pumps of the same stroke sizes. And ample stocks of spare parts are maintained at Mid-Continent and California locations.

Aldrich Direct Flow units are available in 3″, 5″ and 6″ stroke sizes, with 3, 5, 7, or 9 plungers . . . range from 10 to 2400 hp. Pressures are available to meet requirements (up to 15,000 psi or higher).

Write for catalogs, engineering service or a representative's call. We invite your inquiries.

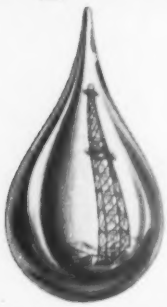
THE ALDRICH PUMP COMPANY

9 GORDON STREET • ALLENTOWN, PENNSYLVANIA

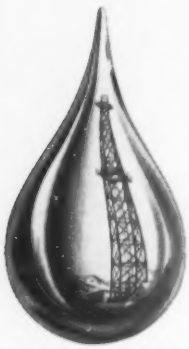
. . . Originators of the Direct Flow Pump

Representatives: P. H. Arden, P. O. Box 185, Glenview, Ill. • Bushnell Controls & Equipment Co., 3929 W. Jefferson Blvd., Los Angeles 16, Calif. • L. T. Gibbs, 509 Petroleum Bldg., Tulsa 3, Okla. • R. B. Moore Supply Co., Inc., Bolivar, N. Y. • Power Specialty Co., 2000 Kipling St., Houston 6, Texas • Reeves & Skinner Machinery Co., 2211 Olive St., St. Louis 3, Mo. Stearns-Roger Manufacturing Co., 1720 California St., Denver 2, Colo. • Export Sales: Petroleum Machinery Corp., 30 Rockefeller Plaza, New York 20, N. Y. • Birmingham • Boston Buffalo • Cincinnati • Cleveland • Detroit • Duluth • Jacksonville • Omaha • Philadelphia • Pittsburgh • Portland, Ore. • Richmond, Va. • San Francisco • Seattle • Spokane, Wash. • Syracuse

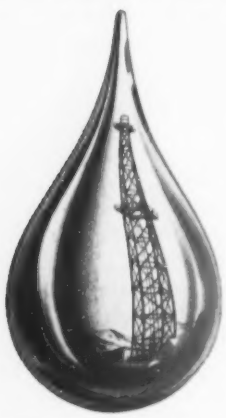
buying caustic soda to better advantage from Mathieson



A petroleum refinery expanding production in the Southwest needed a firm source of supply of caustic soda. Requirements ran to several cars a day and, due to limited storage facilities, close scheduling of shipments was essential.



Like many other petroleum refineries in this area, this plant could be best supplied by Mathieson from production at Lake Charles, Louisiana. Also, only Mathieson could provide the added protection of caustic plants at McIntosh, Huntsville and Anniston, Alabama, and Saltville, Virginia—all within reasonable shipping distance. Mathieson, in addition, is a dependable source of many chemicals essential to refining . . . sulphuric acid, soda ash, ammonia, sulphur, carbonic gas, chlorine, sodium nitrate and sodium chlorite. Moreover, Mathieson often provides an outlet for waste products from the refining process.



These same advantages will be of benefit to you. You'll be sure of top-quality chemicals . . . multi-plant production facilities provide dependability . . . integrated delivery system assures on-time schedules. You'll find you can buy chemicals to better advantage—at any time—by consulting with Mathieson.

caustic soda • soda ash • liquid chlorine • sulphur • sulphuric acid • bicarbonate of soda • ammonia • sodium nitrate • nitric acid • hydrazine • sodium methylate • sodium chlorite • hypochlorite products • dry ice and carbonic gas • ammonium sulphate • ethylene derivatives • methanol

MATHIESON

MATHIESON CHEMICAL CORPORATION
Mathieson Industrial Chemicals Division
Baltimore 3, Maryland

1616

B&W Intermediate Alloy and Stainless CROLOY Tubing Steels

B&W offers a wide range of Intermediate CROLOY and Stainless CROLOY Tubing Steels which permit utmost discrimination in selection of composition. These grades or types have different characteristics and qualities which determine their most economical specific use. Proper selection can be made only after due consideration of all factors involved in a particular application. The metallurgists, salesmen, and technical staff of B&W will welcome the opportunity to assist in the selection of the proper grade or grades best suited to meet specific conditions of service; also, B&W Bulletins TB-1, TB-6, and TB-9, containing a wealth of data on these analyses, are yours for the asking.

ANALYSES OF THE B&W INTERMEDIATE CROLOY TUBING STEELS FOR HIGH-TEMPERATURE SERVICE

TYPE	CARBON	MANG.	SUL.	PHOS.	SILICON	CHROMIUM	MOLY.
CROLOY ½	0.10-0.20	0.30-0.60	0.05	0.04	0.10-0.30	0.50- 0.70	0.45-0.65
CROLOY 1	0.15	0.30-0.60	0.04	0.04	0.30	0.80- 1.10	0.45-0.65
CROLOY 1¼	0.15	0.30-0.60	0.03	0.03	0.50-1.00	1.00- 1.50	0.45-0.65
CROLOY 1¾	0.15	0.30-0.60	0.03	0.03	0.45-0.75	1.50- 2.00	0.60-0.80
CROLOY 2	0.15	0.30-0.60	0.03	0.03	0.50	1.75- 2.25	0.45-0.65
CROLOY 2¼	0.15	0.30-0.60	0.03	0.03	0.50	2.00- 2.50	0.90-1.10
CROLOY 3M	0.15	0.30-0.60	0.03	0.03	0.50	2.75- 3.25	0.80-1.00
CROLOY 5	0.15	0.30-0.60	0.03	0.03	0.50	4.00- 6.00	0.45-0.65
CROLOY 5-Si	0.15	0.30-0.60	0.03	0.03	1.00-2.00	4.00- 6.00	0.45-0.65
CROLOY 5-Ti*	0.12	0.30-0.60	0.03	0.03	0.50	4.00- 6.00	0.45-0.65
CROLOY 5-Cb*	0.12	0.30-0.60	0.03	0.03	0.50	4.00- 6.00	0.45-0.65
CROLOY 7	0.15	0.30-0.60	0.03	0.03	0.50-1.00	6.00- 8.00	0.45-0.65
CROLOY 8M	0.15	0.30-0.60	0.03	0.03	1.00	7.00- 9.00	0.90-1.10
CROLOY 9M†	0.15	0.30-0.60	0.03	0.03	1.00	8.00-10.00	0.90-1.10

NOTE: Percentages are maximum unless range is given.

*Titanium stabilized—Ti 4 x C min., 70% max.; Columbium stabilized—Cb 8 to 10 x C.

†Can also be furnished with 1.20-1.50% Mo, .50% Si—designation CROLOY 9.

ANALYSES OF THE B&W STAINLESS CROLOY TUBING STEELS

B&W Croloy	AISI (A) Type Number	% Carbon Max.	% Manganese Max.	% Phosphorus Max.	% Sulphur Max.	% Silicon Max.	% Chromium	% Nickel	% Molybdenum	% Other Element
Croloy 18-8 H-C	302	.08-.20	2.00	.04	.03	1.00	17.0-19.0	8.0-10.0	..	..
Croloy 18-8 Si	302B	.08	2.00	.03	.03	2.00-3.00	17.0-19.0	11.0-14.0	..	..
Croloy 18-8 F-M	303	.15	2.00	.03	.04	1.00	17.0-19.0	8.0-11.0	..	Se .07-.20
Croloy 18-8 S	304	.08	2.00	.03	.03	.75	18.0-20.0	8.0-11.0	..	..
Croloy 18-12	305	.12	2.00	.04	.03	1.00	17.0-19.0	10.0-13.0	..	..
Croloy 20-10	308	.08	2.00	.03	.03	.50	19.0-22.0	10.0-12.0	..	..
Croloy 25-12	309	.08	2.00	.025	.025	1.00	22.0-26.0	12.0-15.0	..	..
Croloy 25-12 Cb	..	.08	2.00	.025	.025	1.00	22.0-26.0	12.0-15.0	..	Cb 8XC-1.00
Croloy 25-20	310	.15	2.00	.03	.03	.75	24.0-26.0	19.0-22.0	..	(B)
Croloy 16-13-3	316	.08	2.00	.03	.03	.75	16.0-18.0	11.0-14.0	2.0-3.0	..
Croloy 16-13-3 Cb	..	.08	2.00	.03	.03	.75	16.0-18.0	11.0 Min.	2.0-3.0	Cb 9XC-1.00
Croloy 18-13-3	317	.08	2.00	.03	.03	.75	18.0-20.0	11.0-14.0	3.0-4.0	..
Croloy 18-8 Ti	321	.08	2.00	.03	.03	.75	17.0-20.0	9.0-13.0	..	Ti 5XC-.60
Croloy 18-8 Cb	347	.08	2.00	.03	.03	.75	17.0-20.0	9.0-13.0	..	Cb 10XC-1.00
Croloy 12 T	403	.15	1.00	.03	.03	.75	11.5-13.0	..	..	(C)
Croloy 12 Al	405	.08	1.00	.03	.03	.75	11.5-13.5	.50 Max.	..	Al .10-.30
Croloy 12	410	.15	1.00	.03	.03	.75	11.5-13.5	.50 Max	(D)	..
Croloy 12-2	414	.15	1.00	.04	.03	1.00	11.5-13.5	1.25-2.50	..	..
Croloy 18	430	.12	1.00	.03	.03	.75	14.0-18.0	.50 Max.	..	..
Croloy 22	443	.20	1.00	.03	.03	.75	18.0-23.0	.50 Max.	..	Cu .90-1.25
Croloy 27	446	.20	1.50	.03	.03	.75	23.0-30.0	.50 Max.	..	N_2.10-.25

A. For tube manufacturing reasons the analysis of the B&W Croloys may vary slightly from that of the AISI Type Number.

B. Can be furnished stabilized by addition of columbium.

C. Turbine Quality.

D. Can be furnished without or with addition of either ½ or 1 per cent molybdenum as an alloying element.

B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

TA-1762-F

CONTROL PIPELINE MOTION
this dependable, maintenance-free space-saving way

6" I.D. Flexon dual controlled flexing expansion joints on 300 psi steam lines and 3" I.D. dual Flexoniflex units on condensate return line.

with FLEXON EXPANSION JOINTS

Eliminate the dangers of pipeline motion easily and permanently by installing Flexon Expansion Joints. These units are compact and easily installed. They can not leak and require no packing or maintenance of any kind. Just install them and forget them.

Flexon Expansion Joints are offered in three types—Free Flexing in copper or stainless steel for pressures to 30 psi—Controlled Flexing in copper or stainless steel for pressures to 300 psi—High Pressure Flexoniflex units in stainless steel for pressures to 5500 psi. All stainless steel pressure carriers withstand temperatures to 800° F. (1600° F. with special alloys). Copper models pressure and temperature rated according to code. All models are suitable for handling radial, axial and/or lateral pipeline motion.

Write for the name of your nearest Flexon representative.

Complete specifications on expansion joints to meet your needs are given in the new Flexon Expansion Joint Bulletin. Write for your copy today or see Flexonics Expansion Joint Catalogs in Sweet's, Chemical Engineering Catalog and The Refinery Catalog.

Flexonics *Corporation* EXPANSION JOINT DIVISION 1345 S. THIRD AVENUE · MAYWOOD, ILLINOIS

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Flexon identifies products of Flexonics Corporation that have served industry for over 30 years.

Flexible metal hose

Expansion joints

Aircraft components

Metallic bellows

If ever a truck was designed with the driver in mind...

this new Ford Truck is it! New "DRIVERIZED" Cab cuts driver fatigue. New easy handling saves work and time getting around in tight spots. These and many other TIME-SAVING features in the all-new Ford Trucks help get jobs done fast.

Time is money! Today's truck owners know it. Ford Truck engineers know it. That's why TIME-SAVING was a major goal in designing the completely new Ford Trucks for 1953. With scores of new TIME-SAVING features, the new Ford Trucks are made-to-order for your work.

New "DRIVERIZED" Cabs provide living room comfort, cut driver fatigue. They help save time by making driving easier and more efficient in many ways:

Better visibility for instance. Although the new curved one-piece windshield is the most obvious improvement, bigger windows at the sides plus a 4-ft. window at the rear, offer an amazing increase in all-around visibility.

The new Ford Truck seat is something special. Wider, of course. Non-sag seat springs. Adjustable seat cushion *and* separate adjustable back-rest. Most interesting new Ford exclusive feature is that every seat now has a built-in *shock snubber* to help level out the ride.

For easier maneuvering in tight quarters, or in loading and unloading, turning diameter has been considerably reduced. This was done by "setting back" the front axle, widening the front tread, and by improving the steering geometry.

NEW "DRIVERIZED" CABS cut driver fatigue. Both Standard and Deluxe Cab (shown) have new curved one-piece windshield, 55% bigger; new wider adjustable seat; new seat *shock snubber;* new push-button door handles.

New F-900 BIG JOB has 27,000-lb. maximum G.V.W. It's right at home on extra heavy hauling jobs . . . wheels its 8-ton payload at calculated top road speed of up to 60 m.p.h.

Synchro-Silent type transmissions are now standard on all of the new truck models and at no extra cost. This means faster shifting without double clutching and less truck momentum lost.

New LOW-FRICTION design reduces piston travel, cuts down friction "power waste." You get more useable power...*on regular gas.* The 145-h.p. overhead-valve Cargo King V-8 has more power per cubic inch than any engine in its class. The 155-h.p. overhead-valve Cargo King V-8 is the most powerful Ford Truck engine ever built.

And only Ford gives you a choice of V-8 or Six in five different engines.

New Ford service accessibility saves time in the shop. Front ends have been redesigned. Hoods are wider. Frames are wider, too, permitting a new fender contour that makes engines much easier to get at.

Over 190 models in a greatly expanded line give you many more Ford Trucks to choose from in order to get the one *right* truck for *your* job.

FOR COMPLETE INFORMATION on all or any of the new Ford Trucks, write: FORD Division of FORD MOTOR COMPANY, P.O. Box 658, Dearborn, Michigan. State your work and what type of truck interests you most.

Fifty Years Forward — *on the American Road*

FORD *ECONOMY* **TRUCKS**

SAVE TIME! SAVE MONEY! LAST LONGER!

where

MISALIGNMENT

can't be helped . . .

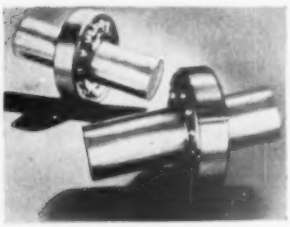
you'll find

SKF

Spherical

Roller Bearings

See how the raceway of the outer ring of this SKF Spherical Roller Bearing forms a section of a sphere. This principle of design of the SKF self-aligning bearings compensates for misalignment due to shaft deflection under load, distortion of the foundation, or other causes.



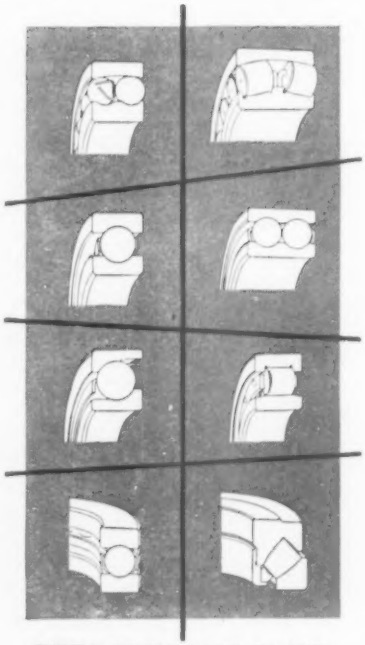
This illustration shows how the principle is also applied to ball bearings, enabling SKF Bearings to operate satisfactorily at high speeds even when some shaft misalignment exists. (The misalignment is exaggerated for clarity.)

Suitable for very heavy radial and thrust loads, SKF Spherical Roller Bearings, like all SKF Bearings, are held well within established tolerance limits, carefully cleaned, protected from rust, and available with cylindrical and taper bores and adapter mountings.

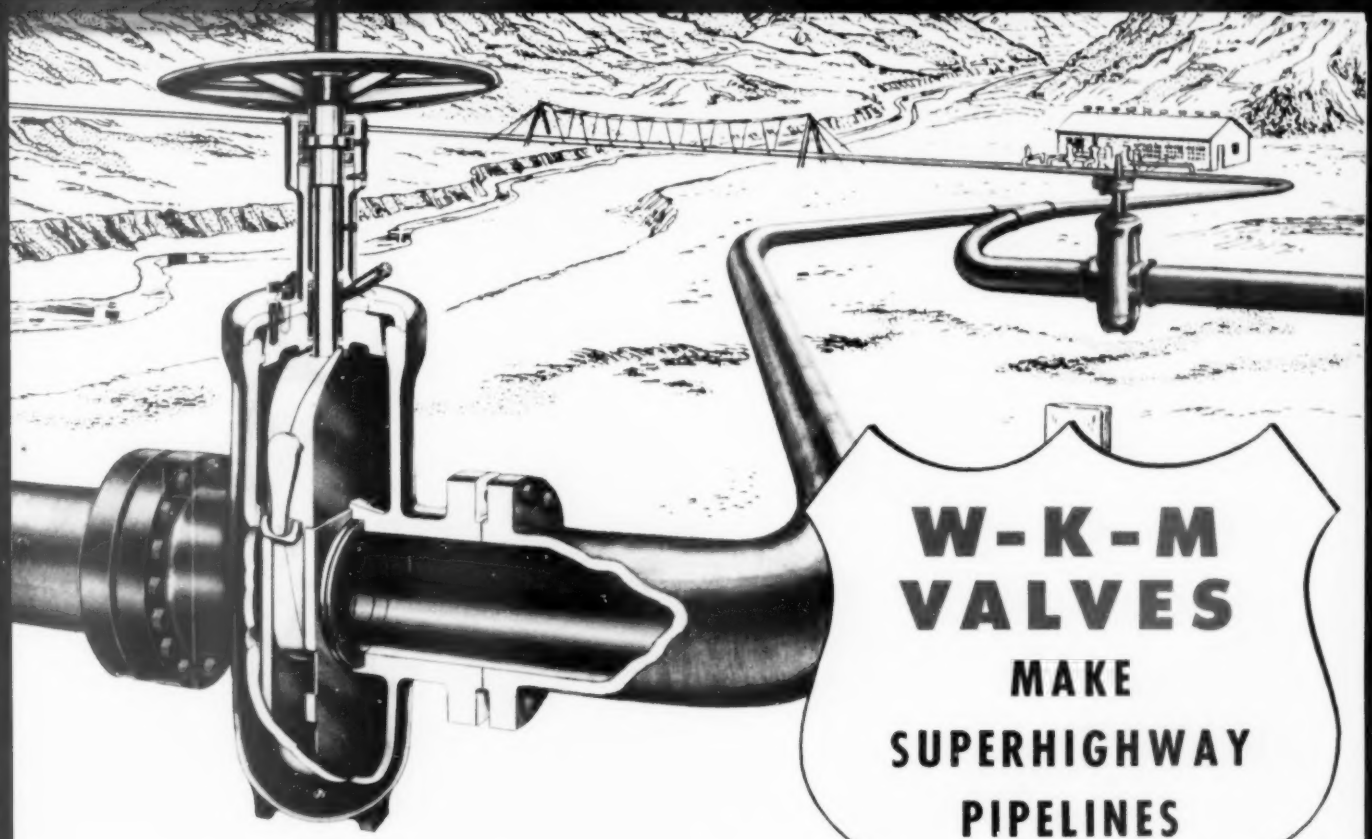
SKF bearings are serving virtually all industry. SKF's unmatched Field and Home Office engineering service helps product designers *put the right bearing in the right place.* **SKF INDUSTRIES, INC.,** PHILADELPHIA 32, PA. – *manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.* 7403

SKF®

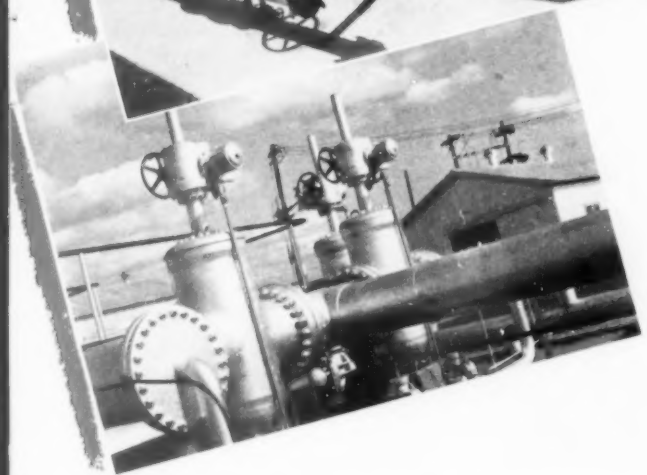
BALL AND ROLLER BEARINGS



SKF'S COMPLETE LINE OF ANTI-FRICTION BEARINGS, PLUS SKF ENGINEERING CO-OPERATION, HELPS YOU *PUT THE RIGHT BEARING IN THE RIGHT PLACE.*



W-K-M VALVES MAKE SUPERHIGHWAY PIPELINES



Full volume, turbulence-free flow without pressure drop and a clear, unobstructed run for scrapers are some of the advantages of using W-K-M Pipeline Valves all the way through the system. Too, W-K-M Valves are the **only** valves of their type which have Leverlock control — a positive mechanical means of controlling the gate and gate segment so as to guarantee easy opening and closing under any conditions.

Write for Bulletin 700-52 which describes W-K-M Valves in detail, see your Composite Catalog, or, better yet, ask for a W-K-M sales engineer to call.

W-K-M Valves

W-K-M COMPANY
P. O. Box 2117 Houston 1, Texas
2330 E. 8th St., Los Angeles, Calif.
Export Office: 30 Rockefeller Plaza, New York, N. Y.

MOST OF THE WORLD'S NEWEST PIPELINES ARE TIED TOGETHER WITH W-K-M VALVES

BUILT BY
PROCON
FOR
ROOSEVELT OIL
& REFINING CORP.

■ The completion of the new major refining units and outside facilities at Roosevelt's Mt. Pleasant, Mich., refinery adds another important installation to Procon's record of achievement. It also demonstrates the versatility of Procon's organization in handling a wide range of work.

NEW 3-UNIT COMBINATION

PLATFORMING
UDEX
PLATREATING

Procon participated in preparing erection drawings and handled the construction of all three units which were engineered and licensed by Universal Oil Products Co. Foundations were placed on piles because that part of the refinery is built on a seven-foot dirt fill.

Procon's field engineers also built a central control room with a large graphic flow panel. In addition, Procon workers built roads, erected an enclosure fence, assisted in the installation of transfer piping — all of which indicates the broad scope of Procon construction service.

PROCON *Incorporated*

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PROCON (*Great Britain*)

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PROCON

24 REFINERS INCREASE DAILY THROUGHPUT WITH PETRECO DESALTING

In one refinery after another, Petreco desalting has promoted operational savings. The resulting fast "pay outs" have rendered the cost of the desalting installation virtually incidental. These fast pay outs result from one basic factor – *Petreco desalting enables the refinery to run more crude.*

The table below shows typical results of Petreco desalting in twenty-four refineries recently surveyed. These refineries charge a wide variety of crudes. Note the barrels of crude run per day – before, and after, desalting. Note the number of days on stream – before, and after, desalting. Note the percent increase in throughput. Why not have these benefits in your refinery? They easily pay for the cost of desalting, and result in substantially more profitable operations.

No.	TYPE OF CRUDE	GRAV. °API	BBLS. PER CAL. DAY		% INCREASE	NO. OF DAYS ON STREAM	
			BEFORE DESALTING	AFTER DESALTING		BEFORE DESALTING	AFTER DESALTING
1	OKLA. ASPHALT	16	950	1,900	100.0	1	75
2	TALCO, WINNSBORO	21	10,500	14,000	33.0	14	360
3	STEPHENS, ARK.	29	1,200	2,000	66.6	10	90
4	SO. LA. SWEET	38	11,000	13,000	18.2	100	125
5	NO. TEXAS SWEET	37	6,760	7,540	11.5	26	78
6	KANSAS SWEET	30+	3,360	3,820	13.7	37	125
7	MICHIGAN LIGHT	44	3,000	4,000	33.3	18	180
8	MIXED CRUDES	16-38	13,000	17,000	30.8	90	180
9	NO. TEXAS-OKLA.	40	8,000	10,000	25.0	33	145
10	GULF COAST	33	15,000	17,500	16.7	...	...
11	WEST TEXAS, SOUR	32	3,900	4,900	25.5	30	180
12	OKLAHOMA, SOUR	20	1,960	2,840	45.0	30	90
13	SHULER, ARK.	33	15,800	18,000	14.0	7	150
14	NEW MEXICO, SOUR	35	1,350	2,150	59.0	...	...
15	WEST TEXAS, SOUR	34	1,000	2,500	150.0	10	40
16	MICHIGAN	38	2,800	3,500	25.0	2	60
17	HASTINGS, SO. TEXAS	31	31,102	41,184	32.4	29	65
18	NO. TEXAS, OKLA.	40	4,000	4,940	23.5	90	180
19	MID CONTINENT	37	4,450	4,950	11.2	45	225
20	RANGER, NO. TEXAS	41	6,000	8,000	33.3	...	...
21	WEST BRANCH, MICH.	33	1,500	3,000	100.0	4	30
22	MICHIGAN	37	14,300	22,100	54.5	...	...
23	SANTA MARIA	14	2,200	2,700	22.7	60	365
24	WEST TEXAS, SOUR	33	1,850	2,750	48.5	90	386

The only "cheap" feature of Petreco desalting is the cost. Equipment, engineering and service are the best obtainable – that's why Petreco desalting is cheapest in the long run. Get complete information today. Write or call

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DISTILLATES: ACID TREATING; CAUSTIC TREATING; DOCTOR TREATING
FUEL OILS: DESAPONIFICATION, ASH REMOVAL

PS 53-1

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THIS formula, used in calculating mud weight increases, may not appear on the record but your Baroid engineer knows this formula (and countless others) by heart. With his experience and detailed knowledge of drilling and drilling muds, and the complete field laboratory built into the back of his car, he's ready at all times to speed to your rig and help you with your problems. There are no fees for his service, for it's a part of Complete Drilling Mud Service.

* X — number of 100-lb sacks of weighting material needed per 100 bbls. of mud.
Y — increase in mud volume due to weighting.
W_1 — initial mud weight (lbs./gal.)
W_2 — final mud weight (lbs./gal.)

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They Say—

On Oversupply . . .

Texas Blames Oklahoma

"There are still 30,000,000 bbl. more of crude and products above ground in the United States today than a year ago. . . . Today it would be even larger except for the foresight and courage of Ernest Thompson and his fellow members of the Texas Railroad Commission. If the importers and producers in other states had acted with the same courage and foresight, our problem of balancing short-term supply and demand would have been closer to solution.

"Texas cuts, approximating 400,000 bbl. daily, mean a loss in revenue to Texas producers collectively of nearly $1,000,000 per day. By any yardstick the Texas producer has made his contribution to the foremost industry problem. Unfortunately, like the United States in Korea, he is fighting almost alone. His allies, Oklahoma, Kansas, and Louisiana, give him only lip service.

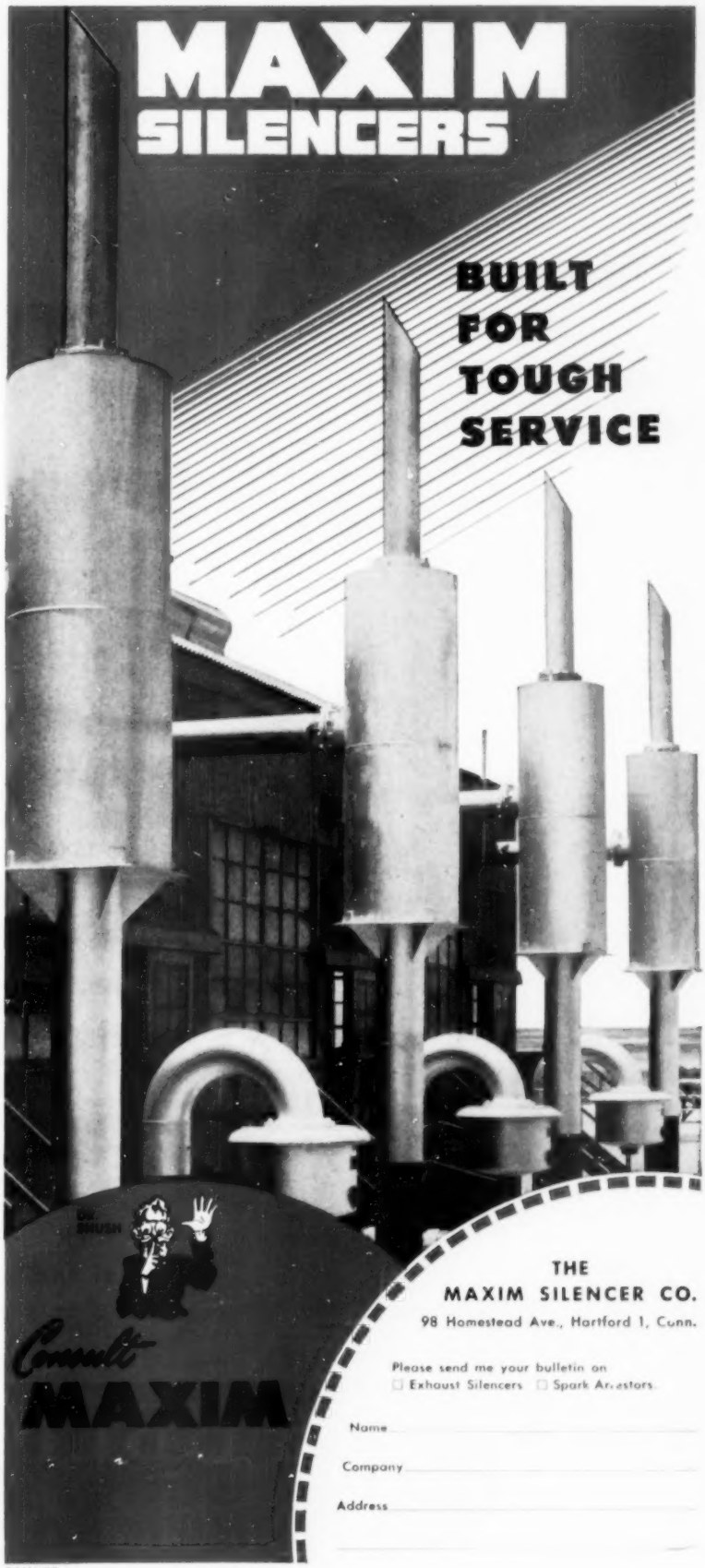
"A large part of our present oversupply is due to excessive imports . . . But congressional action is not the answer. If we legislate the importers . . . how do we legislate Louisiana, Oklahoma, Kansas, and New Mexico with their combined production of 1,500,000 bbl. per day? The contribution of those states has been no more substantial than that of the importers."

R. W. Windfohr, president of Texas Mid-Continent Oil and Gas Association, addressing a meeting of the group, Amarillo.

Oklahoma Accuses Texas

"I would first like to answer the question . . . about the origin of the 6,000,000 bbl. increase in natural crude stocks. To be blunt about it, more than 15,000,000 bbl. of the said 6,000,000 bbl. came from the State of Texas. For example, on January 31, 1952, there was in storage crude of Texas origin 119,138,000 bbl.; on January 31, 1953, there was in storage crude of Texas origin in the amount of 134,235,000 bbl. During the same period crude stocks of Oklahoma origin decreased by more than than 5,000,000 bbl.

"Now, if Mr. Bob Windfohr, and some of the other people in Texas who are so fond of making speeches, would just take the time to read the oil page in some of their daily newspapers, or refer occasionally to The Oil and Gas Journal, they would find out where



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Largest in the South

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MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

the excess production is coming from, and that we (Oklahoma) are in no way responsible for the position in which they find themselves.

"This whole thing boils itself down to one basic fact, and I mean no reflection on the Texas Railroad Commission, but West Texas producers are trying to chisel in on a market which has been historically Oklahoma's together with the states of Kansas, Illinois, Michigan, Kentucky, and Indiana. The Great Lakes crude marketing area has always been primarily served by those states.

"We are soon to be faced with our own import problem. Oil from Canada will soon be invading the Great Lakes marketing area. Also, the oil produced from the eastern slope of the Rocky Mountain area will in the natural course of events find its way into the marketing area now being served by Oklahoma crude. I want to say that I sincerely sympathize with Texas producers, but I do not sympathize with them to the extent that I am going to recommend that this commission cut Oklahoma allowables in order to fit their picture.

"Under no set of figures used can Oklahoma be charged with, in any way, having contributed to the present oversupply of crude oil, whether you use stock figures, MER, or reserves."

Walker T. Pound, director of conservation, testifying before Oklahoma Corporation Commission.

Business Now on Trial

"Today's key problem of acute concern to industry is this:

"Business is on trial in Washington. And business also is on trial in Wall Street and Main Street.

"Unless businessmen do their part at home to maintain a high economic level and a high degree of intelligence in dealing with the public, business will be back in the dog house, where it had been for more than a score of years.

"In the days of Horatio Alger and Calvin Coolidge, business was the pin-up hero. Then came the financial crash and the depression. That tragedy gave every rabble-rouser a chance to blame business, regardless of the injustice of the smear.

"It has taken business more than two decades to climb back to where it is respected and trusted again.

"But the current popular confidence is a fingers-crossed faith, which could be changed into a thumbs-down rejection, if this time a pro-business government and private business enterprise muff the ball. This may well be Custer's Last Stand with a completely socialistic government waiting behind the sand dunes as an alternative."

Sinclair Weeks, Secretary of Com-

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- Refinery Castings
- Heat-Treating Parts
- Conveyor Chains

Of utmost importance in extreme corrosion service are castings that are sound *all the way through!* To make certain you receive only the highest quality alloy castings that can be produced, *ESCO* employs closely controlled scientific techniques for non-destructive inspection and testing. This is only one of the many reasons why an *ESCO* high alloy casting in your worst corrosion trouble spot will outlast others *many times over!*

ESCO metallurgical engineers work with more than 40 different high alloy steels every day... making pioneering contributions to the art of producing castings of unsurpassed corrosion resistance.

ESCO will be glad to recommend the *right* high alloy casting to combat *your* particular corrosion trouble. Whether you need one casting or an entire installation, your inquiry will receive prompt attention.

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merce, addressing the Magazine Publishers Association, Inc., White Sulphur Springs, Va.

Waterways Inexpensive

"More and more industries are taking advantages of the low-cost mass transportation afforded by the inland waterways. In addition to petroleum products, large quantities of coal, chemicals, grains, sulfur, scrap iron, alcohol, methanol, molasses and other products are in daily movement on the inland waterways system.

"The major oil-producing areas of the country is most cases are either on navigable waterways, adjacent thereto, or connected by pipe line to water terminals. Even where the producing area may be some distance from water transportation . . . the industry is finding it profitable to make capital investments in pipe lines to deliver this crude oil to points where it can be transported by water.

"Waterways transportation is also available to most of the large refining centers of the country. . . . Although the oil industry uses every means of transportation, most refineries and producing fields are located or made accessible to mass transportation by barge and tanker."

M. C. Dupree, transportation manager for Ashland Oil & Refining Co., in an address at the semiannual meeting of National Petroleum Association, Cleveland.

CALENDAR OF EVENTS

JUNE

24-27 Intermountain Association of Petroleum Geologists, fourth annual field conference, Ben Lomond Hotel, Ogden, Utah.

June 28-July 2 American Society of Mechanical Engineers, semiannual meeting, Hotel Statler, Los Angeles.

June 28-July 2 Petroleum Equipment Suppliers Association, annual meeting, Broadmoor Hotel, Colorado Springs, Colo.

June 29-July 3 American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

JULY

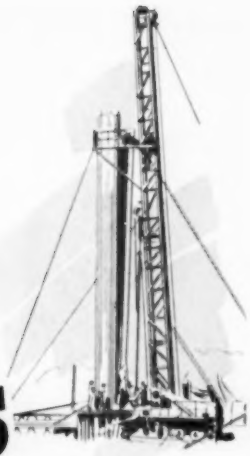
July 30-Aug. 1 Wyoming Geological Association, eighth annual field conference, University of Wyoming, Laramie.

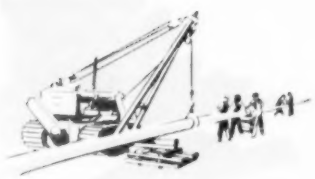
AUGUST

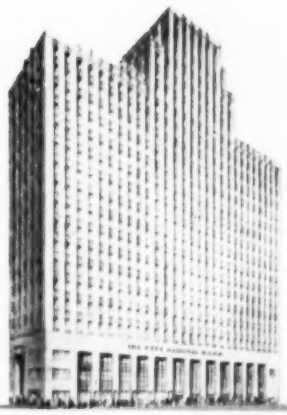
17-19 Society of Automotive Engineers, international West Coast meeting, Georgia Hotel, Vancouver, B. C., Canada.

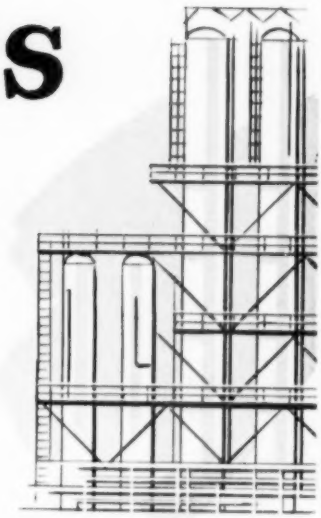
18-21 American Institute of Electrical Engi-

Serving America's Oil and Gas Industries









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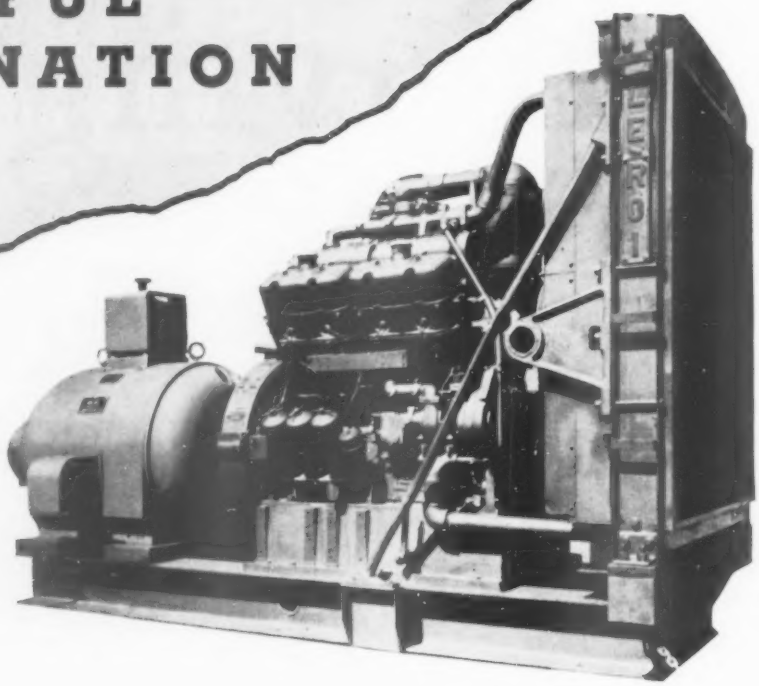

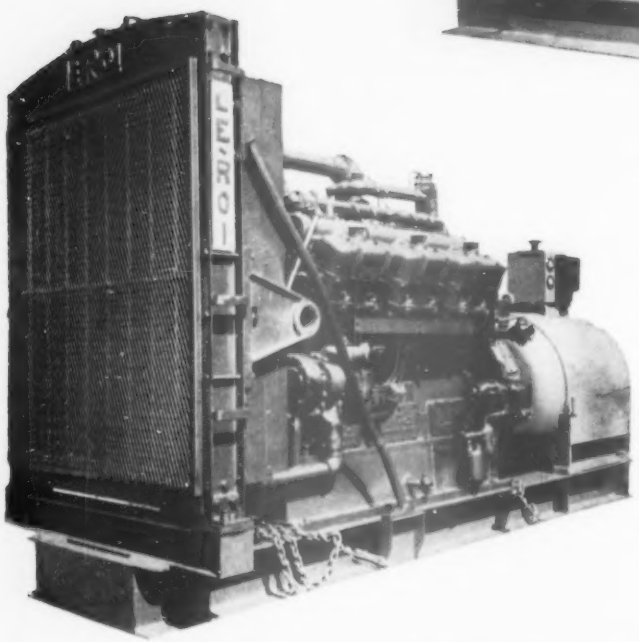

Above: H 2000 — 8 cyl. — LeRoi
Left: L 3000 — 12 cyl. — LeRoi
The above generator units installed to furnish electric power in a gasoline plant in Texas.

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neers, Vancouver Hotel, Vancouver, B. C.

24-26 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

Aug. 31-
Sept. 1 Interstate Oil Compact Commission, Northern Hotel, Billings, Mont.

SEPTEMBER

6-11 American Chemical Society, national meeting, Conrad Hilton Hotel, Chicago.

9-11 Pacific Coast Gas Association, San Francisco.

11-12 Association of Desk and Derrick Clubs of North America, annual meeting, Cosmopolitan Hotel, Denver.

13-16 American Institute of Chemical Engineers, Fairmont and Mark Hopkins hotels, San Francisco.

15-16 American Petroleum Institute, executive committee, Greenbrier Hotel, White Sulphur Springs, W. Va.

16-18 National Petroleum Association, annual meeting, Hotel Traymore, Atlantic City, N. J.

21-25 Instrument Society of America, national instrument conference and exhibit, Sherman and Morrison hotels, Chicago.

24-25 Western Petroleum Refiners Association, regional meeting, Henning Hotel, Casper, Wyo.

27-30 American Society of Mechanical Engineers, annual conference, petroleum division, Rice Hotel, Houston.

28-29 Independent Natural Gas Association of America, Shamrock Hotel, Houston.

Sept. 30-
Oct. 2. American Association of Petroleum Geologists, Mid-Continent regional meeting, Masonic Building, Wichita.

OCTOBER

1- 2 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans.

6- 7 Texas Mid-Continent Oil and Gas Association Rice Hotel, Houston.

7- 9 National Association of Corrosion Engineers, south central region, Mayo Hotel, Tulsa.

8- 9 California Natural Gasoline Association, annual fall meeting, Ambassador Hotel, Los Angeles.

11-17 Oil Progress Week.

19-20 Independent Petroleum Association of America, annual meeting, Texas Hotel, Fort Worth.

22-23 Western Petroleum Refiners Association, regional meeting, Garrett Hotel, El Dorado, Ark.

26-29 American Gas Association, annual conference, Kiel Auditorium, St. Louis.

29-31 Rocky Mountain Oil and Gas Association, annual convention, Cosmopolitan Hotel, Denver.

NOVEMBER

3- 4 Society of Automotive Engineers, national diesel-engine meeting, Conrad Hilton Hotel, Chicago.

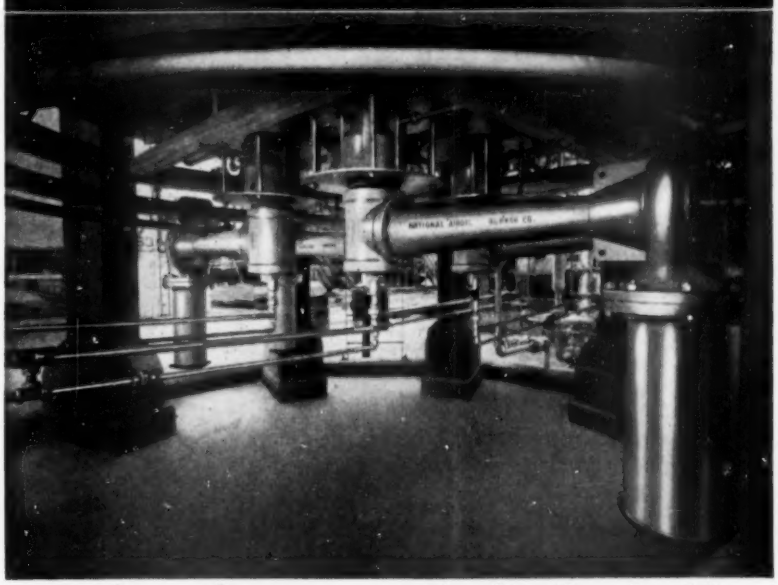
5- 6 Society of Automotive Engineers, national fuels and lubricants meeting, Conrad Hilton Hotel, Chicago.

5- 6 American Association of Petroleum Geologists, Pacific section annual meeting, Hotel Biltmore, Los Angeles.

9-12 American Petroleum Institute, annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

21 National Gasoline Association of America, regional meeting, Herring Hotel, Amarillo, Tex.

here's a familiar sight!



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NATIONAL AIROIL'S Patented Tandem Combustion Blocks allow secondary air to be easily and accurately controlled. By adjusting air control doors, flame can be shaped to radiate heat uniformly without tube impingement.

The tandem unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame . . . maintains required flame temperature using either fuel oil or gas. With the tandem unit's clean flame, a cold furnace can be brought to full capacity in a short time.

You will realize higher profits from YOUR heaters when NATIONAL AIROIL Tandem Combustion Units are specified.

STEAM ATOMIZING OIL BURNERS
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OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
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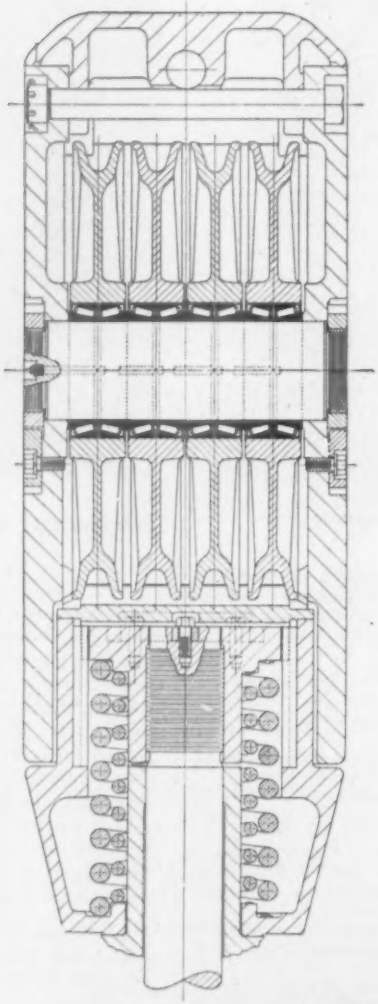

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THE OIL AND GAS
JOURNAL
TULSA, OKLAHOMA

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JOURNALLY Speaking

Gulf Coast Special

ANYBODY who thinks that Gulf Coast oil consists of nothing but offshore operations of the type involved in the tidelands squabble which has occupied Congress for so long should take a look at this Gulf Coast Special. And by Gulf Coast Special we don't mean an excursion train but this issue of our favorite oil publication, which is devoted almost entirely to operations along the southern fringe of Texas and Louisiana.

Most of the Gulf Coast operations are on land — technically, at least, though a lot of the swamp and delta areas aren't exactly what would be classified as terra firma. Experiments in these watery regions taught the industry how to become amphibious, thus leading, eventually, to the spectacular—and politically controversial — developments out in the open ocean. You might say that along the Gulf Coast the industry learned to wade before it learned to swim.

In any event, Gulf Coast operators developed drilling barges and other techniques which are unique throughout the world's oil industry, thus making aquatic operations a Gulf Coast special.

Special Province

IN addition to its marine operations, the Gulf Coast is a separate oil province in a number of other respects. Salt domes, for instance. It got its start with the Spindletop dome more than 50 years ago and specialized on salt domes for a long time thereafter. The hunt for salt domes was, in considerable part, responsible for development of the gravity meter and probably also of the seismograph. In this way a Gulf Coast specialty became a boon to the rest of the industry, for while salt domes aren't found much anywhere else, the methods used in hunting for them are mighty useful in locating other types of oil traps.

The Gulf Coast also taught the industry a lot about deep drilling and handling high-pressure fields and pioneered in treatment of condensate fields and cycling operations. If the Gulf Coast province had kept all its knowledge to itself it might have done all right but the rest of the industry would have been worse off. By borrowing from other places and passing on new technological developments the entire industry makes progress.

New Specialty

NOW the Gulf Coast is concentrating on a new specialty — petrochemistry. That's a magic word, and can mean anything from nylon hose to quick-wash soap powder, or from wrinkleproof suits to plastic seat covers. To the Gulf Coast oil industry, petrochemisty means erection of multimillion-dollar plants which provide important new markets for natural gas and refinery byproducts, of which this area has an abundant supply.

Petrochemistry is one of the nation's fastest-growing industries, and it couldn't pick a better place in which to grow, what with the Gulf Coast's raw materials, local markets, and water transportation. There's just one possible fly in the ointment: As an article in this issue points out, such plants need whole rivers of fresh water, and that's one of the few things Texas has not done much bragging about.

That's Our Boy

THERE'S a by-line in this issue which might be familiar to old-time readers with long memories: C. D. Lockwood. Clarence was on the Journal's staff back in the '20's handling news and statistics of wells drilled and field developments. He liked the work and was good at it, so much so that he left and set up his own reporting service. After doing somewhat the same type of work with the Petroleum Administration for War during the late unpleasantness with Germany and Japan, Clarence started over again with a new slant and really went to town. He tells about his service in an article in this issue.

Henry D. Ralph

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Price rise: justified but ticklish to hold

THE current attempt to increase the price of crude oil is recognition that costs have risen tremendously in the 5½ years since the last general increase in postings at fields producing the bulk of the nation's oil.

But the increase comes at a time when the immediate supply and demand situation makes a higher price ticklish to maintain. Stocks of crude and of petroleum products are at high levels, domestic crude production is appreciably below its maximum efficient rate, and the already high imports of foreign crude could easily be increased.

This raises the question whether the price increase will "stick". That is, whether all elements of the industry will accept the new price as a fair level or whether the competitive urge to get a little bigger share of the market will cause price cutting and bring the whole market structure back down.

THERE can be no disagreement with the statement that the price of oil has been low compared with other commodities and with the costs of finding and producing it. A better price outlook over the next few years is undoubtedly needed to sustain an extensive and vigorous program of exploration and development to find new reserves to replace the oil now being produced.

In price matters the oil industry has always suffered from the long lag required to adjust crude supplies to changes in market demand. It may take 2 or 3 years to achieve a substantial increase in producing capacity, and it is a difficult process to curtail output when supply exceeds demand. Meanwhile, products prices are influenced by short-range changes in supply and demand which may have little relationship to long-range conditions.

That is the situation today. The spot products market is well supplied, and nothing resembling a shortage can be foreseen over the next several months. The shortage which worries the industry is the shortage of crude which will become apparent 2 or 3 years from now unless there is more financial incentive to develop new oil.

THE new price should be accepted by consumers as insurance against a real and costly shortage later on. Producers whose output has been curtailed by state proration should consider it as compensation for adjusting supply to demand. The Government and the nation as a whole should view it as insurance that a reserve producing capacity will be maintained for national defense.

If producers and importers both will accept this small increase per barrel in lieu of greater volume sales, this well-justified price increase will stick and both the industry and the national interest will benefit.

Check and Double Check

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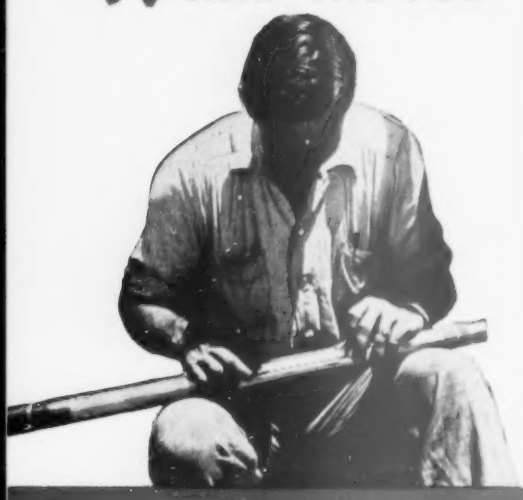
√√ AND THE JOB



Standard Oil Co. [N. J.] Photo

● In line with the ounce-of-prevention precept, the Oil Man checks conditions before cementing a well . . . then double checks by temperature log to see how the cement is distributed around the casing.

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THIS WEEK

GULF COAST concentration of refining facilities is illustrated by this night view of Humble Oil & Refining Co.'s Baytown, Tex., refinery. More than 30 per cent of the nation's refining capacity is now located in the Gulf Coast area. The refinery shown here processed crude oil at a rate in excess of 250,000 bbl. daily during 1952.

PRICES.—Crude-oil prices go up generally 25 cents a barrel except for California and Pennsylvania. . . . Indications are price will stick, giving the industry its first boost since 1947. . . . Some firms raise product prices immediately, with indications gasoline and heavy fuel will bear the brunt of the price hike. . . . Refiners, operating with lower-than-normal realization and some soft markets, faced with difficult problem. . . . Indications are Middle East crude will remain unchanged temporarily. . . . Steel companies raise price of tubular goods to oil industry as a result of recent wage increase granted steel workers. . . . Increase ranges from $5 to $9.50 or more a ton. . . .

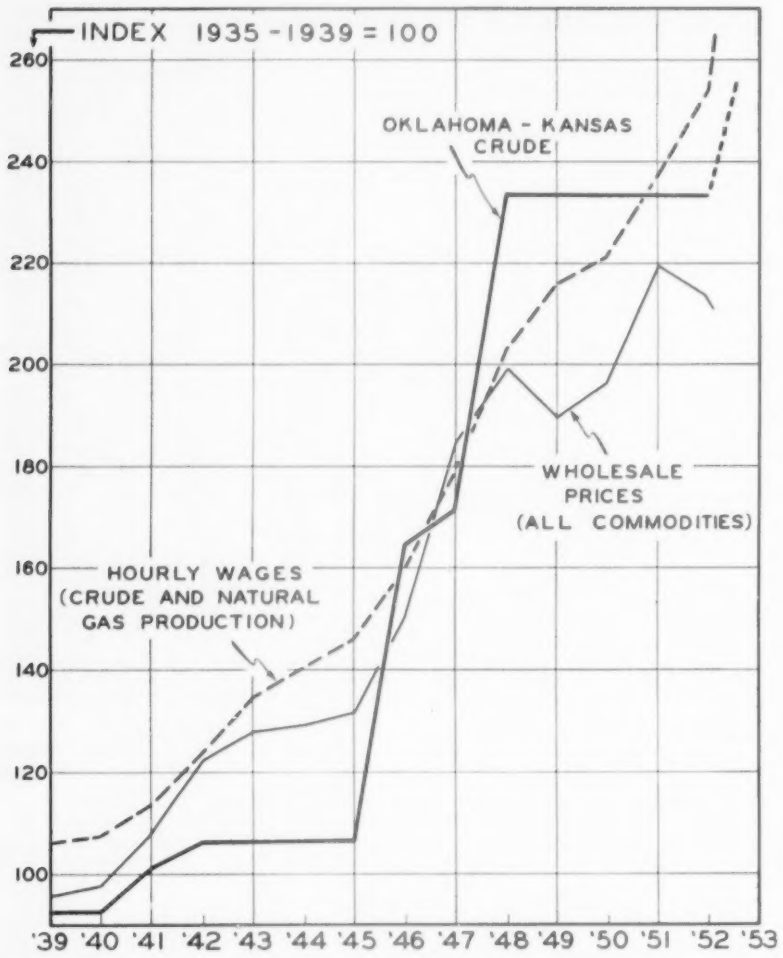
PIPE LINES.—Northwest Natural Gas Co. withdraws its application for permission to lay a natural-gas transmission line from Alberta to serve eastern Canadian markets in hearings before the Alberta Conservation Board. . . . This leaves only two firms contending for the permit at the current hearing—Trans Canada Pipe Lines and Western Pipe Lines. . . . Trans Canada testimony places Alberta's proved, probable and possible gas reserve (as estimated by DeGolyer & MacNaughton) at 18.7 trillion cubic feet. . . . ¶Testing now complete on 250 miles of Trans Mountain's 711-mile, 24-in. crude trunk line from Edmonton, Alta., to Vancouver, B. C. . . . More than 500 miles of the big line have been laid, and completion of the entire project now is set for August. . . .

ACTIVITY.—Production of crude and lease condensate averaged 6,468,325 bbl. daily for week ended June 13, up 80,800 bbl. daily. . . . ¶Total well completions increased 91 wells to 975 for the week. . . . ¶Wildcat completions were up 17 wells to 212. . . . ¶Rotary rigs operating in the United States increased 10 rigs for week ended June 15 to 2,631. . . .

TRENDS.—Changes in price of 36°-36.9° Oklahoma-Kansas crude for past 15 years are shown by the following postings: 1938, $1.02 on October 12; 1941, $1.07 on April 1 and $1.17 on May 19; 1946, $1.27 on April 1, $1.52 on July 25, and $1.62 on November 25; 1947, $1.87 on March 10, $2.07 on October 15, and $2.57 on December 6; 1953, $2.82 on June 15. . . .

EXPLORATION.—Phillips, Kerr-McGee enter Alaska this week to begin first big-scale private exploration operations. . . . Companies hope to spud in first wildcat in October in program which will test a million-acre block along 120 miles of Gulf of Alaska coast. . . . ¶Coring operations to begin soon in vast Athabasca oil sands in northwestern Alberta. . . . Scientist predicts commercial oil production from the area within 5 to 10 years. . . . Current exploratory work expected to throw more light on size of reserves, believed to be one of the world's largest. . . .

PRODUCTION.—New application of microscopic analysis determines origin of water entering oil-producing formations. . . . New process, called "Aquatrace," identifies minute particles eroded from surface over which water passed, thus determining water's source. . . . ¶Unitization of city of Long Beach properties with those of other operators in Wilmington field advocated by oil committee of city council. . . . Group urges charter amendment permitting city to join unit. . . .



TRENDS SINCE '39 in crude prices, wages, and commodity prices, expressed as indexes with the average for 1935-39 taken as 100. For an analysis, see text.

Crude Prices Rise

Higher product prices, jump in exploratory work, squeeze on small refiner expected to follow Phillips-led boost

CRUDE-OIL prices throughout the nation were 25 cents a barrel higher last week except in California and in the Penn-Grade producing area, and the general feeling in the industry was that this time the raise would stick.

The price hike was a general across-the-board increase, except for specified areas or fields along the Gulf Coast and parts of Texas. Here postings were raised as high as 35 cents for "low-cold-test" crude and for crude with a high gasoline content. For some less desirable crudes, the raise amounted only to 10 cents a barrel. There were also adjustments in Rocky Mountain postings. In Michigan, Leonard Pipe Line Co. announced a 30-cent increase for all Michigan oil.

The increase, first announced by Phillips Petroleum Co. June 15 and met almost immediately by many of the majors and independents, indicated these developments:

. . . **A coming squeeze** on the independent refiner. With a soft market for some of his products there is a question whether he will be able to hike product prices enough to cover the added cost of the crude.

. . . **A higher price** for gasoline and probably heavy fuel oil, with an increase on home-heating distillates also coming along in late autumn.

. . . **An increase** in exploratory activity throughout the country resulting from the added incentive to find new reserves.

. . . **An increase** in secondary-recovery activity, both in the cases of stripper areas where a higher price has been needed to justify the expense of water flooding, or in newer fields where operators have been on the economic borderline on decisions of pressure maintenance.

Industry reaction . . . Independents and majors alike hailed the price boost enthusiastically. Some felt it wasn't enough to cover the increased costs of finding and producing oil, but many foresaw the possibility of a further increase later in the year.

A minority believed the higher prices wouldn't hold. These producers pointed to the fact that stocks of both crude and products are high, that the nation's productive capacity is greatly in excess of current demand, and that imports could be increased quickly to meet any sudden demand increase. They also pointed out that some crude in the Rocky Mountains has been moving recently below posted prices.

All producing companies saw the move as a long-needed adjustment to bring the price of crude oil into line with the increased costs of finding and producing it.

Hines Baker, president of the nation's biggest producing company, Humble Oil & Refining Co., spoke for most of the nation's producers in pointing out that crude prices have not advanced generally since December 1947.

"These prices today (before the increase) average less than in 1948," Baker said. "Meanwhile wholesale commodity prices generally have increased substantially. Rates of pay and costs of materials used in oil production have increased more than prices generally; and combined costs of finding, developing, and producing oil have advanced even more. These facts mean that crude-oil prices have not reflected the decline in the value of the dollar nor any part of the large increase in costs that has occurred in the past 5 years."

Greatest justification for the price hike was seen by many in the higher costs for exploration — the fact that fields are becoming harder to find and that each year the average well must be drilled deeper, at much greater expense.

Refiners' outlook . . . Independent re-

finers were frankly worried by the development.

Processing costs have increased, and for the past 2½ years there has been a downward trend in the refiner's realization from a barrel of crude. Together, these factors mean that it is impossible for the refiner to absorb the crude-oil increase. Only alternative is to raise product prices enough to cover at least the added crude cost. The refiners also feel they need something extra in order to raise realization to a level slightly higher than it was in 1951 to pay for some of the increased processing costs.

In Washington M. H. Robineau, president of the Independent Refiners Association of America, declared refiners are now operating at below-normal margins and termed the crude increase a "critical problem."

Robineau called for an immediate increase in product prices, saying the refining industry "should exercise the industrial statesmanship of which it is capable" and make immediate adjustments.

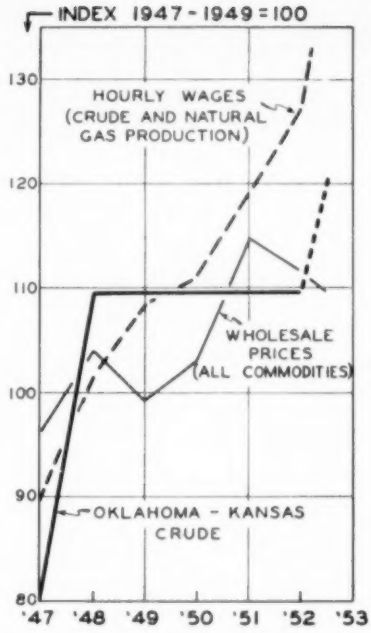
Effect on products . . . Announcements by suppliers made it obvious that gasoline would bear most of the price hike. It was also expected that residual would carry part of the load. This was indicated by the firmness of the residual market and the fact that an increase in home-heating oils probably would discourage filling of secondary and consumer storage during the summer months.

Suppliers indicated that the spread between regular and premium gasolines would be increased at the refinery. The differential now is about 1 cent, with a 2-cent spread at service stations, but the increasing demand for premium has increased the refiner's costs out of proportion to the increase in revenue.

Continental Oil Co. and some other suppliers announced increases for gasoline, residual, and intermediate products. It had been expected that there would be some higher postings for home heating oils, but it was doubtful that sales at these prices would reach large volumes before the rush to fill storage just before the heating season.

It was expected, too, that product price increases would vary, resulting in larger spreads between "lows" and "highs" quoted on the spot market. At present the difference between the "low" and "high" for regular gasoline on the Group 3 spot market is only ⅛ cent. This spread could climb to a cent a gallon over the next month.

Background . . . The price increase initiated by Phillips was the first for crude outside California and Pennsylvania since December 6, 1947, which pegged



TRENDS SINCE '47, using the average for 1947-49 as 100, since this is nearer the time of the last crude-price increase. For details, see text.

Oklahoma-Kansas 40°-gravity oil at $2.65 a barrel.

Once since then, on November 11, 1948, Phillips posted a 35-cent increase, but the raise didn't stick. Sinclair and several smaller purchasers met the increase, but when other large crude buyers failed to meet the new price, Phillips and Sinclair returned to the old postings on December 17.

During the war the industry was saddled with a fixed top of $1.25 a barrel for Oklahoma-Kansas crude. On April 1, 1946, the Office of Price Administration permitted a 10-cent increase. Following the lifting of price controls, crude went up 25 cents on July 25, 1946, and another 10 cents on November 25, moving the top to $1.70.

Three raises were effected in 1947: March 10, 25 cents; October 15, 20 cents; and December 6, 50 cents, which brought the top Mid-Continent price to $2.65.

Other areas . . . It appeared there would be no immediate crude increases in either California or the Penn Grade areas.

In California the talk last week was of climbing crude stocks and the possibility of an oversupply of 200,000 bbl. daily by fall (see West Coast). Too, there have been 10 changes in crude prices on the West Coast since the end of 1947. These changes have reflected California's need for light crude. Crudes with fair gasoline yields have advanced three times during the period, although heavy crudes lost ground during the period of surplus residual in 1949. Some of the loss has been regained because of the increased military demand for heavy fuel.

The Penn Grade area has seen 15 changes since the end of 1947. Although the last eight have been increases, the present price of $4.40 a barrel still is under the $5.00 price that existed at the end of 1947. This is due to the soft demand for lubricating oils, created largely by the upsurge of European refining and the resulting big drop in export demand. The last increase for the Penn Grade area was a 15-cent hike on February 16.

Economics involved . . . The accompanying charts show relative changes in recent years in crude prices, oil-field workers' wages, and the average wholesale prices of all commodities, plotted yearly except for the part-year 1953.

The increase for this month represents the gain over the average for 1952 and not the gain in a single month. The index of wholesale prices of all commodities plotted for 1953 is the average for the first 5 months of the year. The crude price for 1953 is the new price after the 25-cent increase, and not an average for the first 5½ months.

Both charts show that workers' wages in the oil fields have increased at a greater rate than crude prices, even after the latest raise. Not reflected are such things as the higher salaries required for technically trained personnel or the increase in total number of workers required in the oil industry.

In the case of the wholesale commodity index, the figures include many items not used in drilling, such as farm products and food. Most of the material used in drilling has increased at a faster rate than the average for all wholesale prices. Steel, for example, a principal cost item, went up in price again last week, further increasing the cost of oil operations at a time when the wholesale-price index still was falling (see next page).

Also, the measurable increases in material and labor to not reflect higher costs due to deeper drilling and the larger percentage of wildcats. The operator's reaction to the narrowing profit margin between the price of crude and replacement costs was shown in the very small increase in wells planned in 1953 *(see The Oil and Gas Journal, January 26, page 190).*

Consequently, the price boost will make it possible for some operators to drill wells that represented too much of a risk under the old prices. More of these marginal wells will be drilled in the last half of the year.

Price Effects Abroad

Best guess is that Middle East prices won't change for a while, Canada will go up; Venezuela faces loss of markets

NEW YORK.—The $64 question in the foreign oil business last week was whether the price of crude oil in the Persian Gulf will go up.

On a historical basis, the Persian Gulf price should go up correspondingly with a general boost in United States. But there was good evidence last week that it will remain unchanged at least for the time being.

Since the last general increase in crude prices in the United States in 1947, the Persian Gulf price has dropped on three occasions—to $2.03, to $1.88, and finally to $1.75—independent of any changes in this country. Contracts for Persian Gulf crude are not now tied to United States prices although many contain escalator clauses.

Nobody professed to have the final answer last week on whether, when, or how much the Persian Gulf price might change. There are pressures in both directions. Operators whose normal tendency might be to leave the present price stand will be under pressure from the governments of the producing countries to make an increase. Profit-sharing deals on a 50-50 basis are now universal in the Middle East, and so the governments have a big stake in the price.

Supply ample . . . The big consideration at present is the abundant supply—some say oversupply—of crude oil in the Eastern Hemisphere. Middle East production has been running at record levels and on preliminary reports was well above 2,400,000 bbl. daily in May.

If the Persian Gulf price holds fast, as some think it will, the result will be a greater incentive to move Middle East crude into the higher priced Western Hemisphere markets.

Even before the increase touched off last week by Phillips, it was at least a few cents cheaper to bring crude from Kuwait into New York Harbor than from Venezuela or the Gulf Coast. Such calculations were based on current long-term tanker charters at USMC minus 25 per cent and included paying the 10½ per cent U. S. duty. Another 25 cents on the domestic price makes such shipments much more attractive.

Europe . . . Traditionally, prices of products in Europe are priced on the basis of the lows of the Gulf Coast quotations. However, there have already been signs of a breakaway from this historical basis. Italian refiners in some cases have been selling below the formula price.

The products market in Europe at present is described as being none too strong. There is considerable excess refining capacity available to operate on relatively low-cost Middle East crude. When the current situation finally shakes out, products prices in Europe may be largely independent of the United States prices.

Canada . . . General feeling last week was that Canadian crude prices will rise in response to the 25-cent boost in the United States. There seemed to be little doubt that Venezuelan crude prices will go up similarly. Venezuelan royalty prices are tied to U. S. crude and heavy fuel-oil quotations.

Venezuela . . . For the Venezuelan operators, the possibility of unchanged Persian Gulf prices meant an even quicker loss of their remaining markets in Europe. Of equal or greater concern to them was the prospect that Middle East crude would take over more of the choice dollar markets in the Western Hemisphere, not only in the United States but in such countries as Brazil and Canada.

One official last week said that to raise the Persian Gulf price would be like trying to make water run uphill. This individual also did not see any justification for lifting crude prices in the Western Hemisphere, considering the level of stocks and the easy availability of crude.

Pipe Price Hiked

U. S. Steel ups listings from $5 to $9.50 per ton

WASHINGTON. — Prices for oil-industry pipe and tubular goods were increased last week by the National Tube Division of the United States Steel Corp., reflecting an 8½-cents an hour increase in wages won by steel-industry labor.

Increases range from $5 to $9.50 or more per ton.

The price of seamless 2 to 4-in. and butt weld standard and line pipe, black and galvanized, is increased $5 per ton or discounts are reduced 2½ points. Pipe 5 in. in diameter and over is increased $6 per ton, or discounts are reduced 3 points.

An increase of $7 per ton was announced on oil-country casing and tubing, Grade J-55, with proportionate increases in other grades, and a $9.50 increase was set on drill pipe, Grade D, internal upset, with proportionate increases in other grades and types.

Prices of carbon steel seamless, pressure, and mechanical tubing were increased approximate 4½ per cent.

Compact to Get Headquarters

OKLAHOMA CITY.—Oklahoma will build a $75,000 headquarters building for Interstate Oil Compact Commission here.

Under provisions of a bill signed recently by Oklahoma's Gov. Johnston Murray, the structure will be built on a tract east of the governor's mansion and near the capitol. The commission's headquarters are now located in the capitol office building.

If the commission ever decides it does not need the new building, then it will revert back to the state.

Industry Briefs

SACRAMENTO.—Just before concluding its 5-month session the California Legislature voted a 1½-cent increase in the state gasoline tax, effective July 1. The higher tax will be effective for 2 years, after which it will decline ½ cent to 5½ cents per gallon. Currently California motorists are paying 4½ cents per gallon gasoline tax. Diesel fuel tax was raised 2½ cents to a total of 7 cents per gallon. After July 1955 the tax will decline to 6½ cents.

LOS ANGELES.—A decision by the city council on whether drilling will be permitted on the main lot of Twentieth Century-Fox studio in West Los Angeles was awaited last week. Universal Consolidated Oil Co. asked that a 260-acre drilling district be approved. The request had been refused earlier by the city planning commission.

FORT WORTH.—Southern Production Co. has purchased 2,280 net producing acres in Otstot and Vernon fields, Kay County, Okla., from Dave Morgan Oil and associates. Purchasing price was $1,000,000 subject to a retained oil payment of $1,000,000 out of 80 per cent of production. Included in the purchase are 63 oil wells and 1 gas well. The property's daily production currently amounts to 1,000 gross bbl. of oil and 1,250,000 cu. ft. of gas.

Oversupply Feared

California producers see possibility of huge surplus this fall; cut in imports or heavy-crude output talked

D. H. Stormont

LOS ANGELES. — Students of the West Coast supply - demand situation are becoming more concerned about oversupply.

Supply may exceed demand by more than 200,000 bbl. daily this fall, they figure, when 120,000 bbl. of Canadian crude daily begins arriving on the coast through the Trans Mountain line.

The situation is something of an about-face from that of a year ago. Then stocks were low and California production was smaller. While today there is no "alarm," the industry is concerned, since stocks are estimated to have increased at a rate of 65,000 bbl. daily since the first of the year and are now believed to be going up at a rate of more than 80,000 bbl. daily.

Stock situation . . . Caused both by higher imports and increased crude output from California fields, total stocks of petroleum on the West Coast are estimated to be about 10,000,000 bbl. more than on January 1. They are believed to be some 25,000,000 bbl. over those of a year ago.

The Bureau of Mines placed total stocks on April 30 at 102,712,000 bbl., up 2,612,000 bbl. in the month. During May a gain of about 5,000,000 bbl. was estimated by the Oil Producers Agency, based on American Petroleum Institute weekly estimates. During June the Agency reports showed continued additions, but at a slackened pace because of reduced imports.

Large increases have been made in crude and all principal product stocks. Bureau figures as of April 30 showed the following stocks and increases over those of a year previous: Crude 34,604,000, up 4,200,000 bbl.; gasoline and naphthas 22,838,000, up 4,500,000; stove oil and diesel fuel 11,201,000, up 4,100,000; fuel oil 15,987,000, up 6,600,000; and cracking stocks 12,419,000, up 4,100,000 bbl.

During May, a time when gasoline stocks normally are declining, the Oil Producers Agency estimated they gained 39,000 bbl. daily. Stove oil and residuals gained seasonally, and crude stocks were estimated to have gained 25,000 bbl. daily.

Supply picture . . . California fields currently are estimated to be producing 1,015,000 bbl. daily, a gain of about 27,000 over that of January. Principal source of the increase is Elk Hills, producing about 22,000 bbl. daily as compared to only 7,600 bbl. in January. Soon the Navy is expected to raise the field's output to about 32,000 bbl. daily.

The factor which has contributed most to the inventory growth, however, has been increased receipts from outside District 5. During the first quarter they averaged 95,000 bbl. daily, more than twice those in the same period of 1952. During March they ran 137,000 bbl. daily, in April they jumped to 180,000 bbl., and during May the Producers Agency estimated them at 176,000 bbl. daily.

Of these receipts the great bulk was foreign crude, principally from Sumatra and Arabia.

No move yet has been made by West Coast independents toward getting these imports curbed. It is believed, however, that the importing companies soon will be asked to curtail their imports. If they desire to continue importing these high-gravity crudes, it is believed highly possible the companies will be asked to declare a holiday in the development of their heavy - oil fields.

Work Starts on New Building

Officials of Continental Oil Co. and Texas National Bank participate in ground breaking ceremonies in downtown Houston for a new 21-floor, $10,500,000 office building which the two companies will own jointly. Wielding the spades are L. F. McCollum (left), Conoco president, and Harris McAshan, president of Texas National Bank. The oil company's executive, southern region, and Houston marketing division offices will occupy the top seven floors of the structure. Under the agreement, Conoco will own the top 10 floors, the bank will own the 10 lower floors, and each will have a 50 per cent interest in the remaining floor.

Amendment Pushed

Long Beach seeking way to join Wilmington unit

LONG BEACH, Calif.—The oil committee of the Long Beach City Council has recommended that a charter amendment be prepared which would permit unitization of the city's oil properties with those of other operators in the Wilmington field harbor area.

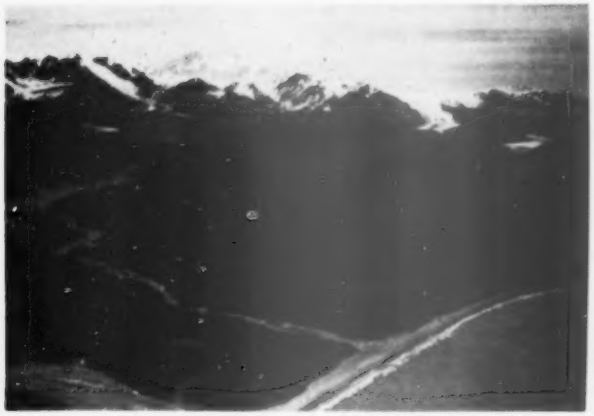
It is planned that the amendment would be voted at a special election to be held this fall.

Such an amendment is regarded as necessary before a pilot water and gas-injection program now started at the harbor properties can be expanded throughout the field. General Petroleum Corp., Union Pacific Railroad, and Continental Consolidated Corp., principal offsetting companies, all have indicated a willingness to pool their properties. Under the existing charter, however, City Atty. Irving M. Smith believes this cannot be done.

Initial water flood . . . Meanwhile the Harbor Department is proceeding with a small water-injection program in an upper Terminal sand in fault block 5-B. A shallow well capable of producing 10,000 bbl. daily of filtered ocean water has been completed and two injection wells drilled.

This project will be operated by Long Beach Oil Development Co., contract operator of the parcel where the flood shortly will be started. Richfield Oil Corp. has signed an agreement for operation of gas and water-injection programs in the parcel it operates. This clears the way for the initiation of similar programs in fault block 6.

About 6,000 M.c.f. of gas daily is now being injected through three Terminal zone wells of Long Beach Oil Development Co. in the first Wilmington project opened recently. The project will be expanded if successful.



CAPE YAKATAGA, looking northeast, showing type of terrain Phillips and Kerr-McGee crews will encounter in their unusual exploratory project.

KATALLA AREA, looking southward. Strip of land at left is Kayak Island, which appears at bottom of map on opposite page.

Million-Acre Block to Be Tested

Preliminary work to begin this week on unusual wildcat program of Phillips, Kerr-McGee to test 120-mile strip

Ted A. Armstrong

THE first big-scale private exploration attempt in Alaska will get under way this week.

An LSM, a 215-ft. Navy-developed landing ship, loaded with road-building equipment, camp trailers, generators, and supplies is scheduled to leave Seattle June 25 and head for a Fourth of July amphibious landing in Icy Bay.

Arriving by plane to meet the ship will be crews of Phillips Petroleum Co. and Kerr-McGee Oil Industries, Inc., which jointly will conduct a program aimed at determining the oil possibilities of a million-acre lease block on the southern coast.

Soon after the camp is set up, Phillips will undertake a program of aerial photography and surface geology work, with the expectation that a location for the first wildcat will be selected in September. Kerr-McGee personnel will begin an immediate program of road, camp, and air-strip building. The preliminary work will be aimed at a goal of spudding in the first wildcat in October. A new 8,500-ft. rig will be bought by Kerr-McGee within the next week or two for the Alaskan operation. The rig will be shipped north from Long Beach, Calif.

What is involved . . . The difficult and expensive exploratory program will test an area long known for its surface oil seeps and for a history of minor shallow production which began shortly after the turn of the century.

It is a rugged, virtually unpopulated coastal belt about 15 miles wide, stretching from iceberg-filled Icy Bay on the east to a point near the port of Cordova. In contracting for the unitized block, now held on a 50-50 basis by Phillips and Kerr-McGee, Phillips agreed to drill 12 wildcats over a period of 10 years, to spend a minimum of $1,200,000 for exploratory work before June 30, 1956, and to spend at least an average of 40 cents an acre annually after that.

Portions of the area have been mapped by the U. S. Geological Survey, and the results of this work are available to Phillips.

What reserves must be found to make the venture a commercial success is a subject on which little agreement is found. If commercial reserves should be proven, however, the oil could be expected to find a ready market in the Pacific Northwest and could be moved easily from the coastal zone by tankers serviced by submarine loading lines similar to those used in the Middle East.

Initial operation . . . Because there is no port nearer than Cordova, the first LSM will be beached for unloading on the west coast of Icy Bay in an area protected by an underwater sand bar about 10 miles south of Guyot Glacier.

A second LSM later will be beached and ballasted to serve as a dock for the temporary camp.

Initial operations will involve cutting a road 38 miles along the coast from Yakataga, site of a CAA landing field, to the temporary camp on Icy Bay. The road will cross about 40 streams of varying size.

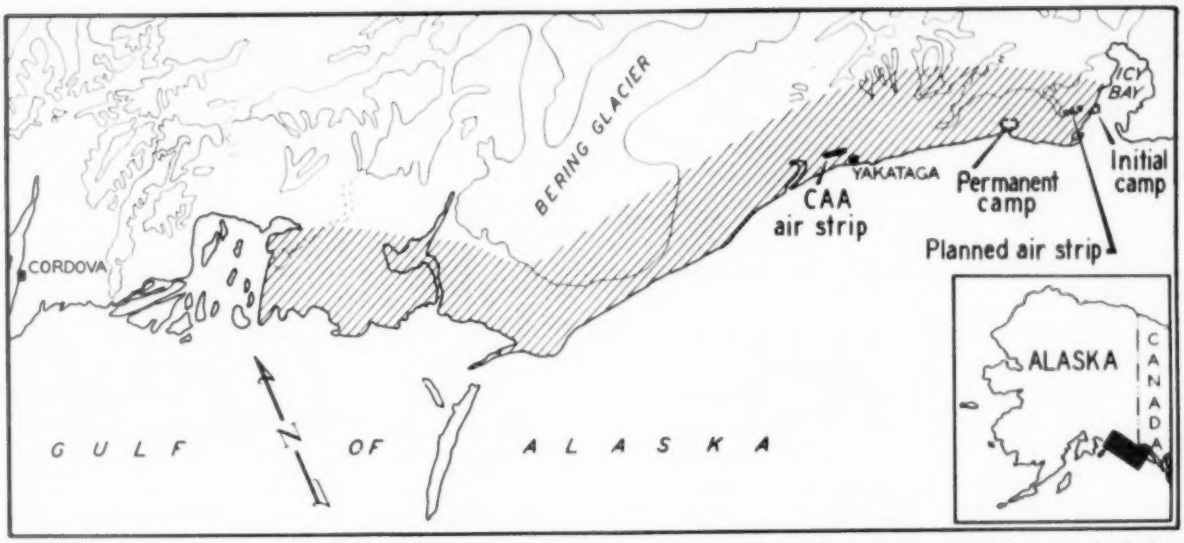
A permanent camp will be built later about midway between Yakataga and the temporary camp. It has not been determined yet whether an air strip can be prepared at the permanent camp. Site selection was dictated by the oil seeps in the area. Only one of the 40 streams crossing the coastal belt in this area is not contaminated by seepage oil, and the permanent camp will be erected close to it as a source of potable water.

It is planned also that an air strip will be prepared at the site of the initial camp on Icy Bay.

Agreements . . . The million-acre block was assembled by Northern Development Co., a partnership of William T. Foran and Ben G. Gellenbeck, who acted for approximately 400 lease applicants and developed the unitization plan.

These leases were acquired by Phillips and are now jointly held with Kerr-McGee in an arrangement providing retention of a 5 per cent override. Royalty owner is the U. S. Government, which receives nothing during the first 5 years and a 10 per cent royalty beginning with the sixth year.

Phillips and Kerr-McGee have entered into two agreements, an operating agreement which establishes Phillips



REMOTE AREA which Phillips and Kerr-McGee will explore is shown by shaded area. Strip is roughly 120 miles long and 15 deep.

as operator in the Alaskan venture, and another agreement "for exploratory activities" under which Kerr-McGee will conduct the drilling. Both of these agreements have yet to be approved by the Interior Department, and actually Kerr-McGee's participation in the project depends upon that approval. Such approval, however, is considered to be only a formality.

Geologic and other work will be done by Phillips, with Kerr-McGee responsible for erecting camps and other facilities.

Background . . . The Phillips - Kerr - McGee venture comes as the Navy is winding up its 8-year exploration program in northern Alaska, during which it spent more than $75,000,000 without finding oil in commercial quantities *(The Oil and Gas Journal, June 15, page 87).*

But the Navy was not the first to seek oil in the Far North. Back in 1901 the enterprising Chilkat Oil Co. drilled its first well, to a depth of 366 ft., in the vicinity of one of the seeps. Between that time and 1919 the company drilled 31 wells, including 18 producers, ranging in depth down to 1,810 ft. All of Chilkat's operations were in the area now held by Phillips and Kerr-McGee.

For 19 years the company operated a small topping plant, but this operation was destroyed by fire in 1933 after processing a total of 154,000 bbl. of crude. All of the Chilkat wells were drilled at existing seeps and none penetrated a large or significant structure.

The Alaskan lands were withdrawn by the Government in 1910 and for the next 10 years there were no leasing provisions. Even after 1920 major oil operators were not interested in the area because of unfavorable lease provisions.

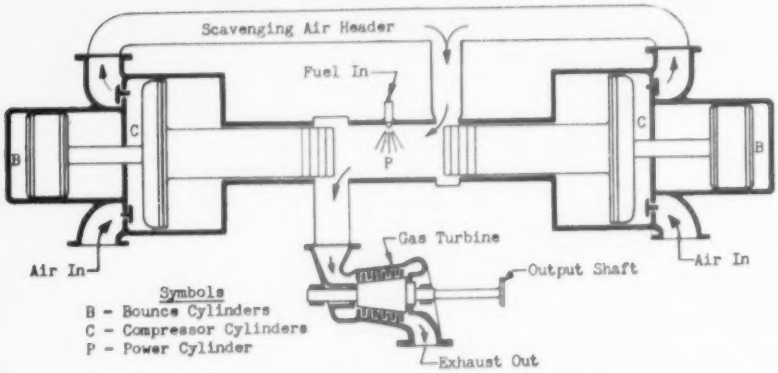
YAKATAGA ANTICLINE as it appears from the air. Road will be built along coast at left. Valley in the upper center is that shown in the smaller photograph of the Cape Yakataga area. Photos courtesy of Bradford Washburn Museum of Science, Boston.

In 1943 the Government again withdrew the lands, on behalf of the Armed Forces, but the Katalla-Yakataga area was released for development in 1947. Even then oil operators were not attracted because leases were limited to a maximum size of little more than 15,000 acres. The present unit operation is a result of efforts of Gellenbeck and Foran to assemble a large block of leases and arrange for a development contract, with the help of the Department of the Interior.

The agreement with Phillips was approved by Interior on February 6, and this was followed the same month by the Phillips-Kerr-McGee agreement.

Foran was in Alaska from 1922 to 1924 with the U.S.G.S. He then joined Standard Oil Co. (N. J.) as a geologist and served with the company until World War II, when he again went to Alaska, this time as geological director for the Navy. It was after he left the Navy in 1947 that he began organizing leasing of the Katalla-Yakataga area. Gellenbeck, an independent lease operator, has been engaged with Foran in the project since 1948.

(For a detailed article on the geology of the Phillips-Kerr-McGee area, prepared by William T. Foran, see The Oil and Gas Journal, April 14, 1952, page 124.)



SCHEMATIC DIAGRAM of free-piston gas turbine.

Revolution in Engines?

Free-piston gas turbine, now under development, may be an answer to climbing fuel and labor costs of pipe lines

DEVELOPMENT work on a revolutionary new power plant, which its maker claims will save gas-transmission lines millions of cubic feet of gas daily, is rapidly nearing completion.

The new prime mover is the free-piston gas turbine, now under development by Cooper-Bessemer Corp. It is said to combine the benefits of smooth rotary turbine power with the fuel economy of today's best diesels and gas engines.

The free-piston turbine is a basically simple opposed-piston, internal-combustion engine without crankshaft or connecting rods. Two pistons, directly opposed in a single cylinder, do the work of the many pistons in the ordinary internal-combustion engine.

Cooper-Bessemer made its first report on its development work on the engine before the American Society of Mechanical Engineers at Columbus, April 29. Further information on the plant was revealed during the International Petroleum Exposition in Tulsa in May. The latest report on the work was made by the company at the eighth annual short course in gas technology at Texas College of Arts and Industries at Kingsville, Tex.

Its advantages . . . This is what Cooper-Bessemer says its new power plant will do:

. . . Cut fuel costs sharply due to its high operating efficiency—said to be as high as 40 per cent compared to a high of about 25 per cent in conventional gas turbines.

. . . Reduce installation costs due to its small size and the fact that it requires a 30 to 60 per cent smaller foundation than conventional prime movers because it is free from vibration.

. . . Cut maintenance costs because of its simplicity and smaller number of working parts.

Cooper-Bessemer engineers say the free-piston turbine will require only 7 cu. ft. of gas per hour for each horsepower, including auxiliaries, compared to the 11 or 12 cu. ft. required by the conventional gas turbine on the same basis.

This would mean a tremendous saving in fuel costs in large-scale transmission operations. On any of the several major gas lines having over 300,000 installed horsepower and fueled on natural gas bled from the line this reduction in fuel consumption would save more than 30,000,000 cu. ft. of gas per day—enough to supply a moderately sized city, the company says.

The free-piston turbine does its work at temperatures within the range of proven steam-turbine practice—meaning that the new turbine can be built with materials easily manufactured and normally available for civilian use. High-temperature alloys needed for jet engines and other vital uses are on high-priority lists and are expected to remain there for a long time.

How it works . . . The unit uses a reciprocating compressor driven directly by combustion thrust against the opposed power pistons. All air is delivered to the combustion chamber where it is further compressed to a very high pressure ratio. Combustion takes place at high thermal efficiency with the free piston serving as the combustor as well as the compressor for the turbine. The free-piston gas generator has no crankshaft, rods, bearings or cylinder heads, and the entire output is in the form of exhaust power gas to drive the turbine. The turbine, since it is a self-contained compressor and combustor, does not have to carry the burden of a large compressor load. Therefore, all of its power is available to drive the useful load.

In contrast, the continuous-combustion type of gas turbine has a rotating low-pressure compressor driven by the gas turbine. Air is delivered to the combustor where combustion takes place at relatively low thermal efficiency. The turbine thus has to provide enough power to drive its own compressor, thereby cutting greatly the power remaining to drive the useful load. The power required for the turbine to drive its compressor is said to be almost two-thirds of the total turbine capacity.

The free-piston turbine runs on low-temperature exhaust gas (about 1,000° F.) in contrast to temperatures of 1,350 to 1,500° F. in most continuous-combustion turbines. It has the highest theoretical thermal efficiency, according to Cooper-Bessemer engineers, of any prime mover, due to its high pressure ratio and its complete expansion down to atmospheric-pressure level.

Ideal efficiencies . . . Ideal maximum efficiencies that can be reached with complete combustion for the free-piston turbine, the diesel, the otto, and the simple gas turbine are 70, 65, 57, and 35 per cent, respectively. Actual engines, however, will seldom achieve more than 50 per cent of the values due to departures from perfect gas laws, friction, throttling, dissociation, and other factors.

The entire answer to the efficiency problem is tied up in the pressure ratios between combustion and the atmospheric line, the engineers maintain. In the free piston turbine and the supercharged diesel, they say, the ratio may be as high as 65 to 80:1; in the simple-gas turbine it is usually 5 or 6:1.

Field testing required . . . Research and development of the new power plant has been directed by the company's Ralph L. Boyer, vice president and chief engineer, and Robert P. Ramsey, consulting engineer.

Though the company is highly enthusiastic about the results of the work so far, it cautions that there still is much to be done in the way of field testing before the units can be manufactured commercially.

New Production Tool

Current tests point to microscopic analysis as certain method of determining origin of water in oil formations

D. H. Stormont

LOS ANGELES.—Microscopic analysis is now being used to determine the source of water produced by oil or gas wells.

If the new technique develops as expected, its use may reduce substantially those costs incurred in shutting off water coming from some place in a well other than the producing formation. This is so primarily because it is unnecessary to shut in the well or to call a service crew to the well site merely to determine from whence the water is coming. All that it required is a sample of water taken from surface-producing facilities.

The method, called the Aquatrace process, is based on the fact that water moving over any surface erodes that surface to some extent. If water is entering a well through a cement plug or from behind cemented casing, it will contain minute suspended particles which can be detected and identified by specialized microscopic analysis. If these particles are not present, it can be concluded that the water is entering the well from the producing formation.

Use of tracers in the cement at the time of completion of a well, in plugging back, or in remedial work will further broaden the method's application. By knowing where a certain tracer was used, it can readily be determined which cement job is leaking by microscopic study of a water sample.

That the method constitutes an entirely new approach to the problem of determining the source of water entry is witnessed by the fact its developer, Dr. Frederick Frei of Los Angeles, was granted 19 claims on applications for 21 patents.

Extent of tests . . . The method has undergone only limited field tests . . . but has given the right answer in every case so far. Of the approximately 24 well-water samples analyzed in the past 6 months, source of which was definitely known in many instances by the company for which the check was being made, the method correctly identified the water as being either formational or as coming from behind pipe. The fact some of the wells had been completed over 10 years ago did not affect the analysis.

In a few cases where the water source was unknown, the operator was unwilling to accept the finding that the water was coming from the oil formation. In each instance, after employing other water-locating services and attempting further shut-off work, it was concluded that the water was formational.

A sample of water from a 4,000-ft. well of a major company in California was analyzed and identified as being associated with the producing oil formation. Company engineers did not agree. They believed the fault was a leaking casing shoe and accordingly had a $2,000 squeeze job performed. When this failed to reduce the 80 per cent water cut they accepted the finding that the water was formational.

To check the accuracy of the service, another company sent in samples from three wells with the statement that in one case the water was coming from behind the casing. All samples were correctly identified.

Tracers had not been added to the cement in any of the 24 wells checked. The findings as to whether the water was from the producing formation or not were based solely on the basis of microscopic analysis for minute particles from the formations penetrated.

In wells where cement had been used in two or more jobs and the water was coming from somewhere behind the pipe, it thus was not possible to determine the exact source. Though the general diagnosis was correct, it could not be established whether the casing shoe was faulty, a plug leaking, or up-the-hole water channeling down behind the cement and entering through a casing failure.

Use of additives . . . Adding identifiable tracers to the cement used in completing oil and gas wells is expected to eliminate this shortcoming. Take, for example, a well with a cemented water string to shut off top water, a liner cemented through perforations to exclude intermediate water, and a bottom plug for excluding bottom water. A different tracer could be added in each cement job. Water from subsequent leaks in any of these jobs could be traced readily because of the tell-tale additive particles.

Such tracers would: (1) Have to be foreign to formations encountered in the well bore, (2) be solids which would not dissolve in oil-well fluids and yet be identifiable at all times, and (3) not impair the setting time, strength, or other properties of the cement.

In this connection extensive studies completed by a large oil-well cementing company have shown that additives will leach out of the cement if in contact with moving fluids, and that addition of only 2 or 3 per cent of the tracer is sufficient for identification purposes. The tests further established that adding up to 10 per cent of the tracers did not change the strength or setting time of the cement.

Because of the method's reliability as indicated in initial field checks, some engineers are of the opinion the application of additives should be made standard practice in oil-well cementing.

Most water-locating methods currently used determine only the point at which the water is entering the well —not where the source is. Water believed to be formational actually may be some which has worked its way downward behind the cemented pipe for hundreds of feet and then entered the well through a leaking casing shoe.

When this knowledge is coupled with chemical-analysis data, the source may be located. But unless data are available on every water-bearing formation penetrated, the actual source may be overlooked. This would be especially true if several waters were similar in composition.

Because of the versatility of the Aquatrace process and the fact that use of tracers problably will add but little to the cost of cementing, the method may become a valuable new tool for determining source of the water. Comparatively a low-cost method, there is no necessity for shutting in a well, or having a service crew go to the well site to determine from whence water is coming. A small sample of water taken from surface-producing facilities, without any conditioning of the well, is all that is needed for the microscopic determination.

Problem seen . . . While some of the checks made to date were on wells in which cement had been used for various purposes, none have been made on any in which thick pay sections are produced through cemented, gun-perforated pipe. This condition, it is believed, poses a special problem to unlimited use of the microscopic method.

One major company, which is considering use of the service for all its future wells, shortly will sponsor an investigation to determine the reliability of the method under these conditions.

Public-Lands Report

Geological Survey reports royalties from production on all government lands last year netted U. S. $36,165,300

WASHINGTON.—A total of 1,038 producing oil and gas wells and 470 dry holes were drilled on government lands under the supervision of the Geological Survey in 1952. A total of 759 producers and 325 dry holes were on the public lands.

A summary of last year's operations just completed by the Survey shows that at the close of the year 301 wells were drilling, 248 of them on the public lands. Other lands on which there were oil and gas operations included certain acquired lands, Indian lands other than the Osage Reservation, and military, miscellaneous, and naval-petroleum-reserve lands.

On all these lands, a total of 81,741 leases were outstanding January 1, 3,751 of which were productive with a total of 14,574 producers and injection wells.

Production during the year included 114,849,000 bbl. of oil, 239,437,900 M.c.f. of gas and 227,460,000 gal. of gas liquids. The royalty return to the federal Government was $36,165,300.

The federal oil and gas operations spread over 33 states, but there were productive leases in only 17, with most of the activity and production centered in Wyoming, California, Colorado, New Mexico, Oklahoma, Louisiana, Montana and Utah.

Production breakdown . . . Production on public lands last year included 93,255,700 bbl. of oil, 169,201,000 M.c.f. of gas and 183,635,000 gal. of natural-gas liquids, from which the Government derived a revenue of $28,530,700.

Production from acquired lands for the year was 4,183,609 bbl. of oil, 3,368,900 M.c.f. of gas, and 1,040,000 gal. of gas liquids, from which royalties of $1,672,700 were secured.

Indian lands output was 14,582,700 bbl. of oil, 51,770,000 M.c.f. of gas, and 33,570,000 gal. of gas liquids, on which royalties totaled $4,578,900.

Military and miscellaneous lands produced 582,000 bbl. of oil, 13,831,000 M.c.f. of gas, and 322,000 gal. of gas liquids, with a royalty of $579,000.

The only naval reserve lands operated by the Survey are those in Naval Petroleum Reserve No. 2 from which production in 1952 included 2,245,000 bbl. of oil, 1,267,000 M.c.f. of gas, and 8,893,000 gal. of gas liquids, from which the royalty to the Government was $804,000.

Details of operations and production on all federal lands under Geological Survey supervision, by states, are given in the accompanying table.

Here's What Happened Last Year on Lands under the USGS

	Lands under supervision of the Geological Survey										All lands	
							Production (sales)					
State—	Leases outstanding 12-31-52	Leases productive 12-31-52	Wells productive and injection 12-31-52	Wells comp. Prod.	Wells comp. Dry	Wells drilling 12-31-52	Oil, 1,000 bbl.	Gas, M.M.c.f.	Gas liquids, 1,000 gal.	Royalty, all products, $000	Total state oil prod., 1,000 bbl.	Total state reserves, A.P.I., 1,000 bbl.
Alabama	35	0	0	0	0	0	0	0	0	0	1,131	10,000
Alaska	206	0	0	0	0	0	0	0	0	0	0	0
Arizona	1,333	0	0	0	0	0	0	0	0	0	0	0
Arkansas	52	3	3	2	1	1	0	0	0	0	27,917	285,000
California	7,642	242	2,161	111	53	34	27,335	25,081	88,667	8,243	359,501	4,618,927
Colorado	5,178	145	388	19	38	10	14,062	28,298	7,777	5,676	30,448	305,691
Florida	98	0	0	0	0	1	0	0	0	0	593	4,000
Idaho	423	0	0	0	2	0	0	0	0	0	0	0
Illinois	3	0	0	0	0	0	0	0	0	0	59,564	585,000
Indiana	11	0	0	0	0	1	0	0	0	0	11,857	55,000
Kansas	146	64	35	2	0	1	24	5,554	0	65	114,818	999,982
Kentucky	2	2	4	0	0	0	0.4	0	0	0.1	11,790	65,000
Louisiana	188	20	109	28	2	2	4,670	14,656	331	1,877	230,403	2,400,000
Maryland	4	0	0	0	0	0	0	0	0	0	0	0
Michigan	100	8	21	2	13	2	32	0	0	12.4	13,242	80,000
Mississippi	825	4	4	1	9	2	54	0	0	17	34,335	435,000
Missouri	1	0	0	0	0	0	0	0	0	0	27	500
Montana	6,640	491	1,072	29	14	12	2,839	4,783	794	969	9,580	156,181
Nebraska	320	1	4	2	0	0	27	0	0	11	2,389	21,836
Nevada	6,315	0	0	0	0	0	0	0	0	0	0	0
New Mexico	10,423	808	3,212	426	91	99	12,797	118,620	54,951	4,536	58,608	780,000
New York	2	0	0	0	0	0	0	0	0	0	4,206	53,000
North Dakota	917	17	21	0	0	0	0	295	0	2	1,599	76,203
Ohio	11	10	52	0	0	0	37.6	72.9	0	18.8	3,241	26,000
Oklahoma	6,784	1,018	3,787	184	91	29	9,349	8,234	33,228	2,787	191,523	1,555,109
Oregon	153	0	0	0	0	0	0	0	0	0	0	0
South Dakota	1,098	0	0	0	0	0	0	0	0	0	0	0
Texas	69	9	8	0	0	0	1	392	322	6	1,480,916	24,182,985
Utah	7,587	47	70	21	39	31	1,039	2,373	0	332	1,749	42,399
Virginia	3	0	0	0	0	0	0	0	0	0	0	0
Washington	102	0	0	0	0	0	0	0	0	0	0	0
West Virginia	36	0	0	0	0	0	0	0	0	0	*2,636	*38,000
Wyoming	25,034	862	3,623	211	117	73	42,582	31,079	41,390	11,613	68,000	1,064,722
Total	81,741	3,751	14,574	1,038	470	301	114,849	239,437.9	227,460	36,165.3	2,720,073	37,840,535

*Includes Virginia. Separate figures unavailable.

Capacity Going Up

PAD releases new figures on oil-refining expansion

WASHINGTON. — An expected increase of 365,000 bbl. daily in domestic oil-refining capacity this year is scheduled to be followed by another 400,000-bbl. increase in 1954 and at least 62,100 bbl. after January 1, 1955, to bring the national total to approximately 8,500,000 bbl. daily.

These increases, indicated in revised estimates just made by the Petroleum Administration for Defense, will be slightly less in 1953 but considerably more in 1954 than indicated in its original estimate of last December.

The new figures have been adjusted to cover revisions in estimated completion dates of facilities planned or under construction and include new projects reported since its last survey. Some adjustments have been made also to bring the figures into conformity with Bureau of Mines statistics.

The present estimates include assured projects reported to PAD as of April 1. Capacity is expressed as maximum daily average throughput obtainable from both operating and shutdown units with allowance for normal downtime for repair, etc.

RATED REFINING CAPACITY
(Thousands of barrels)

PAD dist.	Jan. 1, 1953	Jan. 1, 1954	Jan. 1, 1955
1	1,245	1,356	1,406
2	2,144	2,250	2,359
3	2,827	2,954	3,036
4	262	266	266
5	1,256	1,273	1,338
Total	7,734	8,059	8,405

Development Bill

States would have no part in U.S. area of tidelands

WASHINGTON. — A bill providing the machinery for development of the federal Government's portion of the Continental Shelf, in which the coastal states are given no participation either in management or in revenue, has been laid before the Senate for action.

The measure, approved by the interior affairs committee by a 13-2 vote, authorizes the making of leases for the development of oil, gas, or sulfur, all of which already have been discovered, but does not cover other resources that may be found in the future.

It provides for control of the area by the existing federal laws, but where no applicable federal statute exists, state laws may be applied but will be administered and enforced by federal officers and courts.

All revenue from leases and production will go into the federal treasury, and no power is given for the extention to the area of production or severance taxes by the abutting states.

May cause difficulty . . . The leasing provisions, which require that separate leases be provided for oil and gas and for sulfur, are seen as leading to possible difficulties in Louisiana where leases have been granted covering all three commodities.

Under the bill, the federal Government will permit such leases to stand, but with a condition that if sulfur is not produced within 5 years that part of the lease will be void.

Under federal leases, to be issued by the Secretary of the Interior, a lessee will be given the right to develop either oil and gas or sulfur but if an oil and gas lessee finds sulfur he will have no rights to its production, and conversely if a sulfur lessee discovers oil or gas he will have no rights to its development.

All existing leases beyond state

WATCHING WASHINGTON

Bertram F. Linz

Expansion Survey Set

The plant expansion goals already set up for the oil, gas and other defense industries will be resurveyed by the reorganized Office of Defense Mobilization.

Where necessary, new goals will be fixed to gear defense industries to demands of sudden, total war.

The ODM is no longer a purely temporary agency concerned only with problems of immediate urgency, but a semipermanent organization with authority not only to control the current defense program but to set up in advance bases for the laws and regulations needed in a full mobilization. In the latter field it takes over the work formerly conducted by the National Securities Resources Board, which has become a part of ODM.

Officials of the revamped agency plan to lean heavily on industry for advice and personnel. The plan is to use the uncompensated service of industry leaders as followed by PAD and NPA. Representatives of industry will be called in to advise on price and material control programs in case of a future war.

Most immediate problem of the ODM, however, will be to determine whether greater incentives are needed to attain the expansion goals set out for industry. Some industries have slowed down their effort as peace seemed to be nearer.

Land Disposal Planned

The federal Government, which owns close to 25 per cent of all land of the nation, plans to dispose of some of its vast empire to private or state owners.

Just what lands will be disposed of by the Government has not yet been determined. But Interior Department officials are setting up three categories of general nature into which all lands will fall. These will consist of lands where higher use can be attained by federal management; lands that can be better handled under state ownership; and still others which should be disposed of to private owners.

One of the big problems of government is that of lands acquired or withdrawn for military defense. However, to tie up vast acreages of public lands in withdrawn areas, as has been done in Alaska and some of the western states, is to deny their full and best use to those who could be developing them, officials believe.

There is no prospect that the Government will be able to offer much land to the states or private interests in the near future.

New Priorities System

A new system of priorities on scarce materials for use in production for the military to go into effect July 1 will have little or no effect on the oil industry.

Officials of the Petroleum Administration for Defense and the National Production Authority have been holding conversations on the outlook for materials under the new system and are said to have generally agreed that there will be no important conflict between requirements of the oil industry and those of the military and atomic energy programs.

The new priorities system will be limited to the two defense agencies and will not apply to industry generally.

boundaries will be validated as federal leases. Royalties on production in the Continental Shelf are fixed at not less than 12½ per cent on oil and gas and 10 per cent on sulfur.

Members of the committee did not attempt to specify where state laws would be applicable in the federal Continental Shelf but Sen. Guy Cordon of Oregon, who headed the subcommittee that wrote the measure, said they probably would be merely civil and criminal statutes of a "housekeeping" character.

SOUTHWEST

Corrosion Stopper?

Electric-current control may cut damage to casing

ODESSA, Tex.—A new theory on the cause and a new method for reducing corrosion in casing and tubing, has been advanced by V. C. Crites of Union Steel Co., Los Angeles.

Speaking before the Permian basin chapter of the National Association of Corrosion Engineers here recently, Crites pointed out that unbalanced electrical currents between casing and tubing and surrounding soil and rock could be causing well corrosion. He stated that by maintaining an almost exact electrical balance between casing and tubing and surrounding soil and rock, corrosion may be reduced.

Also, Crites said experiments are now in progress using electrical balance to reduce hard paraffin depositions on the tubing. He advanced the opinion that these depositions are formed from colloidal particles in the oil which are attracted to certain areas of the tubing by electrical currents.

Another approach . . . Another method of reducing production corrosion was discussed at the meeting by H. E. Waldrip of Gulf Oil Corp., Houston. He said the use of certain substances will create an oil film on the tubing's metal surface which would prevent attack by acid gases and corrosive brines.

Waldrip said that 36 per cent of the wells in West Texas are affected by corrosion. The cost of the corrosion, he said, averages about $270 per year before preventive measures are applied and about $220 after they are applied.

It's January in June on This "Indoor Highway"

This automobile is getting the works on a new contraption officially designated the "All-Weather Chassis Dynamometer" lab by its developer, California Research Corp. Vehicles ranging in size up to the largest truck tractor now in operation will be subjected in the Richmond, Calif., lab to rigorous simulated road tests as part of the company's research on automotive fuels and lubricants. The dynamometer system, housed in an insulated cell which can be heated to 120° F. or chilled to —40° F., can absorb 300 hp. at speeds up to 100 miles per hour. Primary advantages of the unit over conventional road tests are that the operating conditions (including speed, grade of hill, airstream, temperature, etc.) can be controlled precisely and the engine under test can be examind while it is running. Engineers recently ran a series of tests in 24 hours on the unit which formerly would have taken at least a week of driving at several widely dispersed sites.

Texas July Allowable Up

AUSTIN. — The Texas Railroad Commission last week set the Texas crude - oil - production allowable for July at 3,103,073 bbl. daily.

This is an increase of 83,639 bbl. daily over the June figure of 3,019,434 bbl. daily.

The commission increased producing days for the state generally in July by 1 day to 21. This includes the 14 fields connected to the Phillips Petroleum Co. Goldsmith plant and the nonflaring leases in the Spraberry Trend area. The number of producing days for East Texas field was left unchanged at 18.

Indications were that the allowable order may be amended later this month to take in the entire Spraberry Trend Area field where many leases which were flaring casing-head gas still are shut in under the commission's disputed conservation order.

New Mexico Tax Opposed

SANTA FE.—Attorneys for Rowan Drilling Co., Fort Worth, are preparing briefs stating why the company should not pay a 2 per cent compensating-use tax on equipment purchased outside New Mexico.

The case, which may set a precedent for other drilling companies in New Mexico, will be reviewed from the briefs by the state revenue commissioner.

Rowan contends equipment purchased outside the state and not used primarily in New Mexico should not be taxed.

Slaughter Field Wells Sold

TULSA.—Warren - Bradshaw Exploration Co., Tulsa, has purchased seven producing wells on 480 acres of leases in Slaughter field, Cochran County, Texas, from Permian Drilling Corp., Odessa, Tex.

The wells are producing from the San Andres formation and have a daily allowable of about 150 bbl. Also, the company plans to drill seven proved undrilled locations immediately.

Pilot Flood Proposed

AUSTIN. — Chapman & McFarlin, Tulsa, oil-producing firm, is seeking permission of the Texas Railroad Commission to conduct a pilot water-flood project in the 1,450-ft. San Andres reservoir in Cogdell field, Kent County.

E. C. Rach, consultant for the applicants, has told examiner Herb McCracken that each of the 16 wells involved produce an average of 7.1 bbl. daily. Input wells have not been selected, but four are likely to be used.

Athabasca Forecast

Famous Alberta oil sands said nearer development

EDMONTON, Alta. — Commercial oil production from the Athabasca oil sands in northeastern Alberta is possible in 5 to 10 years, Dr. Karl A. Clark, professor of metallurgy at the University of Alberta, estimates.

Dr. Clark, who has been connected for the past 3 years with research on the sands, said to contain the world's largest reserve of oil, returned recently from the oil-sands area.

"Five years would be a rush job. Ten years is a sensible, reasonable time," he said.

The most intensive exploration program in the history of the oil sands is under way. An Alberta mines and minerals department spokesman said 13 prospecting permits are in effect in the McMurray, Alta., region. The permits require that a certain amount of exploratory work must be done.

At least two drilling rigs are in the region north of McMurray. These two and others to be sent to the oil sands area will be placed in operation in the immediate future. Cores will be taken to determine the nature and extent of the oil-sands deposits.

Operating jointly on pooled acreage are Calvan Consolidated Oil & Gas Co., Ltd., Asher Oil Co., Pacific Petroleums, New Continental Oil Co., Charter Oil Co., Redwater Utilities and Ponder Oils.

Shell Oil Co. and Sun Oil Co. each have two prospecting permits. Rio Tinto Oils, Ltd., and Socony-Vacuum Exploration, Ltd., will operate independently.

Plant up for sale . . . The government-owned Bitumont extraction plant will be sold by public auction July 9. The purchaser also will receive lease rights which provide for a long-term work commitment. The lease to be auctioned will be only the second offered in the oil-sands area. The first was taken by Abasand Oils, Ltd., a pioneer oil-sands prospector.

The Bitumont plant, 45 miles north of McMurray, separated oil from the sands by the hot-water-flotation method. A subsequent report to the government claimed that the oil from the sands could be produced competitively with oil from pools.

Dr. Clark stated that permit holders are given 3 years to carry out their exploratory work. Exploration programs now are in their second year. After the third year, "it will be very interesting to see what is done."

There is no doubt, he added, that the oil companies are determined to develop the oil sands "at the earliest possible date."

While the exploration programs are being carried out, he said, researchers are busy in oil-company laboratories trying to determine what type of extraction plant should be built. The cost of such a plant could run around $50,000,000, he said.

C.P.R. Loses Rights Claim

EDMONTON, Alta. — An Alberta appellate court has upheld a ruling that Canadian Pacific Railway and Imperial Oil, Ltd., have no claim to oil rights on a piece of land in the middle Leduc field despite an error made in the land-registration office in 1908.

In 1908 Canadian Pacific sold a quarter section of land in the area but retained all mineral rights. However, the land-title office registrar neglected to include petroleum, and the title read "reserving unto the C.P.R. all coal."

In 1943 an attempt was made to correct the error when the registrar added the words "and petroleum." The court ruled that the registrar did not have authority to make such a correction and that the oil rights, valued at $1,000,000, belong to the owners of the land, Anton Turta and his son, Nick.

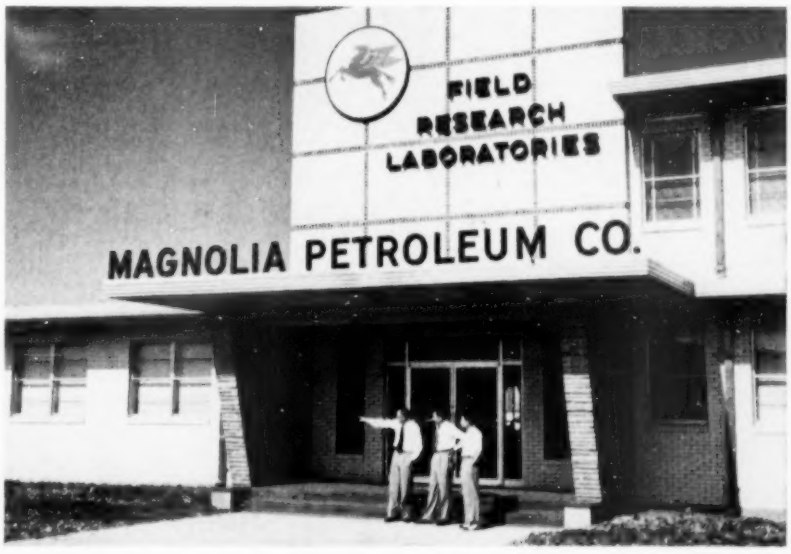
Field Narrowed

Northwest Natural drops plans for gas line to East

CALGARY, Alta. — Northwest Natural Gas Co. last week dropped out of the race to build a transmission line to serve eastern Canadian markets with western Canadian gas.

The application was withdrawn by H. G. Nolan, counsel for Northwest in the hearings here before the Alberta Petroleum and Natural Gas Conservation Board on gas-export proposals *(The Oil and Gas Journal, June 15, page 84)*. The company gave no reason for its action.

The applicants in the hearing now have been pared to two: Trans Canada Pipe Lines, Ltd., backed by Canadian Delhi Oil, Ltd., and Western Pipe Lines, Ltd. Application of the remain-



Magnolia Adds to Dallas Research Facilities

Magnolia Petroleum Co.'s new administration building at the field-research laboratories 10 miles southwest of Dallas is inspected by (left to right) Dr. Dayton H. Clewell, director of the laboratories, and E. S. Wilhelm and John A. Lee, supervisor and assistant supervisor of the general-services division, respectively. The Dallas facilities comprise the only research installation of the Socony-Vacuum Oil Co., Inc., organization engaged exclusively in research problems on crude-oil exploration, drilling, and production. Magnolia is a Socony-Vacuum subsidiary. The research at Dallas includes work in the fields of geology, geophysics, well logging, drilling, petroleum engineering, and oil-field-production practices. The new administration building provides offices for administrative personnel supervising the work of a staff of about 300 employes. Another building, in which research in nuclear physics is conducted, also was completed recently.

ing contender, Mid-Continent Pipe Lines, will not be heard during the current hearing.

Trans Canada plans a line from southern Alberta around the head of the lakes to Ontario and Quebec. Northwest Natural's line would have followed the same general route and served the same area. Western is pushing a proposal to lay a line east to Winnipeg, Man., thence south to serve the St. Paul-Minneapolis area in the United States. This line would be extended later to serve eastern Canada. Mid-Continent's line would serve the same area as the Trans Canada project but would follow a southern route roughly paralleling Interprovincial Pipe Line Co.'s crude system.

Dismissal motion filed . . . Predictions that the hearing would be a stormy hard-fought affair were borne out almost immediately when Trans Canada raised strong objections against the board's considering any other proposal.

The company based its argument on grounds that its competitors had not submitted data necessary to support their proposals by the May 25 deadline. The dismissal motion filed by the company was taken under consideration by the board.

Trans Canada placed proved, possible, and probable gas reserves in Alberta at 18.7 trillion cubic feet in its initial testimony. The reserves estimate was made for the company by DeGolyer & MacNaughton, Dallas, Tex.

Data on reserves and geology now being presented at the hearing are scheduled to be followed by debate on markets, deliverability, and routes.

Development Program Set

EDMONTON, Alta.—Ziegler Exploration Co., of Denver, and Battle River Petroleum Co., Ltd., of Edmonton, plan a development program in western Canada to cost $13,000,000 in the next 2 years, according to an announcement here.

The announcement was made by Dr. Victor Ziegler, head of Ziegler Exploration, who said the program would be started shortly. A mining engineer and a geologist, he is a former professor of geology at the Colorado School of Mines.

Dr. Ziegler said the two companies have been merged. It is expected that they will operate under the name of Ziegler Exploration of Canada, Ltd. The firms hold 9,500,000 acres of land in Alberta, Saskatchewan, British Columbia, and the Yukon, Dr. Ziegler said.

It also was announced that five drilling rigs probably will be brought into western Canada before the end of June to start the program. Drilling will be started in Saskatchewan northeast of Prince Albert and in British Columbia near Vancouver.

The companies hold acreage in the Stettler, St. Paul, St. Albert, and Wizard Lake areas of Alberta.

Trans Mountain Tests Line

EDMONTON.—Testing has already been carried on at two sections of the new 711-mile, 24-in. crude-oil line now under construction by Trans Mountain Oil Pipe Line Co. from Edmonton to Vancouver, B. C.

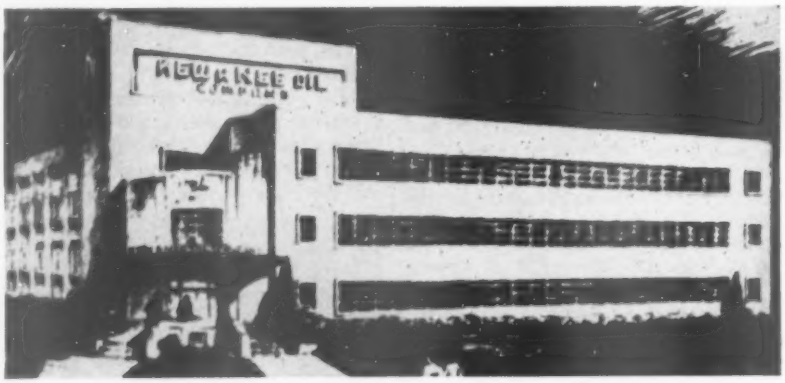
The two sections tested include one of 140 miles and another of 110 miles. More than 500 miles of the line has already been laid.

This month a 5-mile stretch of pipe will be laid in the tortuous Coquihalla Canyon of British Columbia, which probably will be the most spectacular feat of the construction program. The line drops from an elevation of 4,000 ft. at Coquihalla Summit, to an elevation of 150 ft., in a distance of only 30 miles.

Favorable weather conditions so far this year have resulted in such progress that completion of the entire project is now expected in August, with the first oil moving by October.

To accommodate accumulated oil in the line, a 1,000,000 bbl.-plus tank farm near Edmonton is being constructed. It is expected to be completed and in operation by mid-summer.

MID-CONTINENT



ARTIST'S SKETCH of Kewanee's new headquarters in Tulsa.

Kewanee Breaks Ground for New Building

TULSA.—One of the oldest oil-producing companies in the United States broke ground June 18 for its new headquarters office building here.

The concern is Kewanee Oil Co., which was originally organized and incorporated in Pennsylvania on May 26, 1871.

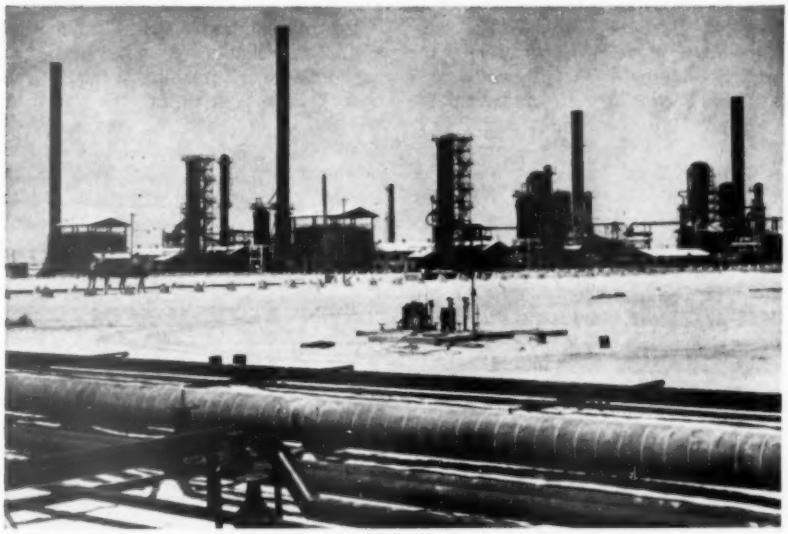
Kewanee's new office building will be located in Tulsa's growing new "oil block" area, situated 8 blocks south of Tulsa's present central business area.

The Independent Petroleum Association of America now has a building under construction in this new oil block area. The American Association of Petroleum Geologists recently moved into its new building here. Skelly Oil Company has acquired the largest site space in the area. A new headquarters building for Sinclair Oil & Gas Co. is under construction some one-half dozen blocks away.

Kewanee's growth . . . The firm started developing oil and gas leases in Pennsylvania in 1871, gradually expanding into West Virginia, Ohio, and Indiana. Kewanee entered the Mid-Continent area in November 1915, establishing offices in Tulsa. The company now operates oil property in Illinois, Kansas, Oklahoma, Texas, New Mexico, Colorado, and Wyoming; it has 2,100 producing wells in these states.

William Wikoff Smith is Kewanee's president, located at Philadelphia. B. D. (Bud) Baker is general superintendent of operations and a Kewanee director, at Tulsa.

While Kewanee's new building is getting under construction, one of its long-time operating officials, J. B. Steele, vice president, is retiring effective July 1. Steele joined Kewanee in 1916, assisting in its growth to one of the large independent producing companies.



BIGGEST REFINERY in the Eastern Hemisphere is Aramco's plant at Ras Tanura on the Persian Gulf in Saudi Arabia. Throughput of this plant rose in April to a record 226,924 bbl. daily.

Aramco Report

Record oil output recorded during 1952 but company says it must prepare for decreases in rate of production this year

Dahl M. Duff

THE year 1952 marked another period of important expansion for Arabian American Oil Co., although it did not match the rapid buildup of facilities in the first few postwar years.

In its annual report to the Saudi Arabian Government giving detailed data on all phases of its operations during the year, the company pointed out that:

. . . **Crude-oil production** was at an all-time high.

. . . **Further drilling** resulted in connection of the Ghawar fields.

. . . **Five** new **separator plants** were constructed by the company.

. . . **Major improvements** were made to the Ras Tanura refinery.

The annual reports to the government are required under concession terms and have been made public since 1948. They provide Aramco with a means of reviewing its activities since the company has no public stockholders who would receive the usual type of annual statement.

No. 1 producer . . . Aramco has ranked as the world's No. 1 oil-producing company since its output surpassed that of Creole Petroleum Corp. several years ago. The company's 824,756 bbl. daily in 1952 made Saudi Arabia the world's fourth largest producing country.

However, in an introduction to the report, F. A. Davies, Aramco board chairman, warned that some decrease in production must be expected in 1953.

"It would be well to observe that the increase in world demand for petroleum appears to have leveled off," he said. "Increasing quantities of sterling oil are available to numerous countries short of dollar exchange. This factor, combined with the probable resumption of oil production in Iran, inclines us to the view that we must be prepared for some decrease in the rate of production of Saudi oil. . . ."

Many activities . . . What would probably impress the average domestic oil operator most in the Aramco report is the number and type of activities in which the company engages aside from its basic job of finding and producing oil. Aramco carries some 200,000 separate items in its field inventories. It builds roads, houses, and shops, lays out townsites, and manages real estate, operates schools and hospitals, runs an agricultural farm, and has just finished construction of the only railroad in Arabia with a deep-sea port.

Among the facts and figures in the report were the following:

. . . **Engineering, supply, transportation.**—Last year, Aramco spent approximately $106,800,000 for commodities, ocean freight, and related expenses. This outlay was divided among the following areas: United States and Canada, $81,300,000; Europe, $20,000,000; Australia and New Zealand, $2,900,000; and Near and Middle East,

CAMELS, DRILLING RIGS, AND SAND are a familiar part of the landscape in Arabian American Oil Co.'s area of operations in eastern Saudi Arabia. This is a typical drilling well in the Ain Dar area. During the past year, continued exploration has shown that the fields of Ain Dar, Uthmaniya, and recently discovered Shedgum form a single oil accumulation which eventually may become the world's largest field.

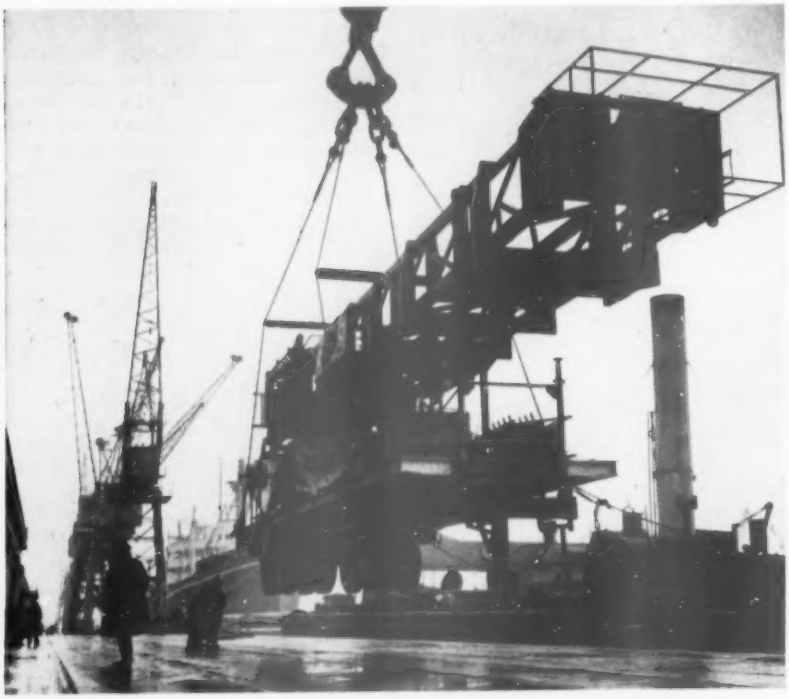
$2,600,000. To improve the company's ability to use nondollar currencies and thus strengthen the competitive position of Saudi oil, Aramco continues to look to Europe and the sterling area for many of its requirements. Purchasing remained under review to discover additional avenues for the use of nondollar currencies received from the sale of oil. Expanding industrial activity in many parts of the world aggravated the company's problems by creating scarcities of technical personnel and materials.

. . . Exploration.—At the end of the year, Aramco had three parties in surface mapping, two in triangulation and leveling, three in gravity meter and magnetometer, two in seismograph, and three in structure drilling with seven rigs. Detailed work was done in coastal Al Hasa, and reconnaissance work in the remote parts of the concession. Fadhili area was further defined by structure drilling. Detailed seismic surveys were carried on in the area of Niarya and Ras al Mish'ab. By the end of 1952, gravity meter and magnetometer mapping had nearly covered the major portion of Central Al Hasa, and final computations and adjustments of the data were in progress.

. . . Drilling and production.—Aramco completed 39 wells in 1952—6 in Safaniya and 33 in Ghawar. The company had 224 wells in the year of the year, including 134 producing, 54 shut-in or standing, 10 observation, 3 suspended, 16 abandoned, and 7 drilling. Aramco's total 1952 production was 301,860,885 bbl. Two new separator plants were built in Ain Dar, one in Uthmaniyah, and two smaller ones in Qatif.

. . . The Ras Tanura refinery.—This plant ran an average of 169,957 bbl. daily during the year. Improvements in process facilities made possible an increase of 29,000 bbl. daily in crude-refining capacity. Other work was completed to permit initial production and drumming of heavy paving asphalt for use in Saudi Arabia. Piles were driven in November for a catalytic polymerization plant, and near the end of the year work began on a crude topping unit designed to permit a further increase of about 22,000 bbl. daily in crude-charging capacity.

. . . Other activities.—A sharp increase was recorded in the sale of refined products within Saudi Arabia. The total was 1,002,000 bbl. in 1952 compared to 635,000 bbl. in 1951. Aramco's automotive fleet was enlarged to 3,242 vehicles. A total of 1,496 tankers and 112 freighters called at the Ras Tanura port during the year. At the end of the year, the company had 24,838 employes compared with 22,395 at the end of 1951. Saudi Arabs made up 59.7 per cent of the total at the end of 1952, Americans 16.4 per cent, and other nationalities, 23.9 per cent.



Portable Rig Leaves London for Bahrein

This portable rig, being loaded from a London dock, was built recently in Britain for Bahrein Petroleum Co., Ltd. It is rated for drilling to a depth of 2,000 to 4,000 ft. and for servicing to 8,000 ft. There are two speeds to the hoisting drum of the draw works and to the rotary table. These are controlled by jaw clutches and are shifted by an air cylinder. The two mechanical ratios, in combination with a torque converter, provide torque multiplication over a wide range of speeds. Contract for this portable equipment was placed by United Overseas Petroleum Co. (purchasing organization for Caltex) with National Supply Co. of London. With the mast lowered, the rig has an over-all height of 16 ft., 6 in.

LATIN AMERICA

Pemex Reports New Strikes

Major exploratory successes are claimed by Petroleos Mexicanos in discoveries at La Angostura and Santa Agueda in Veracruz. An official in Mexico City said the two discoveries would increase production of Pemex by 10,000 bbl. daily.

The Santa Agueda well, the first commercial producer of three wells drilled near Papantla, was reported to have been brought in at about 7,000 bbl. daily. It was drilled in a previously undeveloped extension of the Faja de Oro region in the vicinity of other production at Mazutla, Ordonez, and Horcon.

Pemex said that the new Angostura field was found in an area of the Papaloapan basin in which oil had not previously been found.

Argentine Plant Progresses

Argentina expects to cover about 80 per cent of its requirements from domestic refineries when the new Presidente Peron plant goes into operation within the next few months.

According to official government statements in Buenos Aires, the new refinery will make a total capacity in government-owned facilities of about 112,000 bbl. daily. An additional 40,000 bbl. daily capacity is available in privately owned plants, thus giving the country an aggregate capacity of slightly more than 150,000 bbl. daily.

The new Presidente Peron refinery, located at Eva Peron (formerly La Plata) is a 28,300 bbl. daily installation, including fluid catalytic cracking, alkylation, and one of the world's largest delayed coking units. It is being constructed by the government Yacimientos Petroliferos Fiscales under the supervision of Kellogg Pan American Corp.

The volume of crude oil imported into Argentina increased by 73 per

cent between 1948 and 1952 while domestic crude production increased about 12 per cent over the same period. According to a recent presidential message, the throughput of Y.P.F. refineries in 1952 was about 89,000 bbl. daily (5,158,355 cu. m.).

Creole Activity Increases

Production, refinery runs, and drilling activity of Creole Petroleum Corp. in Venezuela during April all showed a slight increase over the previous month.

Operated production of the company averaged 739,415 bbl. daily against 714,106 bbl. daily in March. Of the April production, 608,315 bbl. daily was from Lake Maracaibo, 5,667 bbl. daily from Cumarebo, and 125,433 bbl. daily from eastern Venezuela.

Refinery runs totaled 140,502 bbl. daily as compared to 137,822 bbl. daily in March. Of the April runs, 60,425 bbl. daily was from Caripito, and 80,077 bbl. daily from Amuay.

The company operated an average of 19 rigs during April against 18.2 the previous month. Fifteen wells were completed in April, including five successful oil exploratory wells. These were: in Cumarebo, 456 bbl. daily initial production and 5,500 ft. total depth; in Maracaibo (two wells) 583 bbl. daily average initial production and 7,154 ft. average total depth; San Joaquin, 185 bbl. daily initial production and 7,096 ft. total depth; and Pilon 1,365 bbl. daily initial production and 3,610 ft. total depth.

EUROPE

British to Explore for Gas

The British Gas Council has decided to carry out an exploratory program in Britain in the hope of finding supplies of natural gas.

The plan was outlined recently to the Institute of Gas Engineers in London by Sir Harold Smith, chairman of the British Gas Council. He said the council had considered a large-scale exploratory program to extend over a period of 5 years and had decided to move ahead with the project after obtaining the assistance of Dr. G. M. Lees, chief geologist of Anglo-Iranian Oil Co., Ltd.

Discussions are now taking place with oil-company officials to arrange for exploration work to start soon. Those connected with the program realize there is no guarantee gas will be found. At the same time it was pointed out that previous drilling in the United Kingdom had been aimed at discovering oil with no special emphasis on natural gas.

Small-scale exploration work has been going on in Britain for years. In 1939, commercial oil production was found at Eakring in Nottinghamshire. Nearly all the present production of about 1,100 bbl. daily now comes from a group of fields in this area which produce from the Upper Carboniferous. Production has been maintained only by extensive water flooding which started at Eakring in 1948 and was subsequently extended to the two other main fields.

Products Tax Cut Asked

The trade association of Italian refiners, Unione Petrolifera Italiana, is asking the Italian Government to reduce the taxes levied on gasoline and other petroleum products.

The purpose of the move is to encourage increased domestic consumption. Since the end of the war, Italy's total refining capacity has expanded at a faster rate than the country's own market, with the result that some facilities are now idle or in partial operation.

The association contends that lower taxes on oil products would not affect the government's revenue since a much greater quantity would be sold. According to a report to U.P.I.'s board of directors, Italian consumption showed an increase of 15 per cent last year while total refining capacity rose 25 per cent.

Italy now has about 270,000 bbl. daily of refining capacity. Total throughput in 1952, according to the report, was about 198,000 bbl. daily. This rate of operation was made possible by export sales outside Italy which last year took about 75,000 bbl. daily of the refinery production.

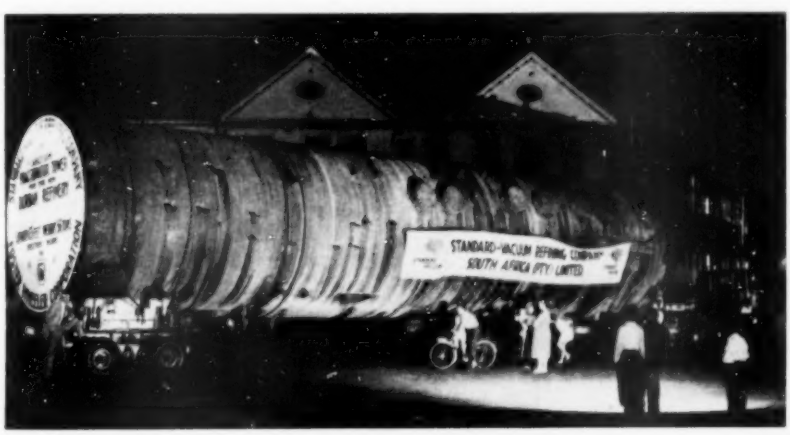
New Products Marketed

Several major new products have been placed on the market in Britain by Imperial Chemical Industries, Ltd., as a result of continued construction of petrochemical facilities at Wilton.

At Wilton on the River Tees, I.C.I. carries out petroleum activities directed primarily to the cracking of oil for the production of basic organic chemicals. Feedstock is petroleum naphtha of Middle East origin. Pipe lines 10 miles in length connect Wilton with other installations at Billingham on the other side of the river.

I.C.I. reported recently that the chlorine works and the second of three polythene units is slated for completion the latter part of this year. Construction is continuing according to schedule on the Terylene (Dacron in the United States) and phthalic anhydride plants.

As a further step toward the full utilization of all materials that the Wilton olefin plant can provide, the carbonylation plant at Billingham has been extended to make butanols from propylene, and the plant for the production of isopropanol has been brought into service. The project for making long-chain alcohols for the detergent industry has made good progress, I.C.I. said.



Fractionator Tower Negotiates Durban Streets

Manipulation of this lower section of a big fractionating tower through the streets of Durban, South Africa, attracted public attention during the early morning hours of May 20. The 56-ton unit, having the largest cubic capacity of any item ever landed at a South African port, is being erected at Standard-Vacuum Oil Co.'s new 15,600-bbl.-daily Durban refinery, the country's first to process imported crude oil. The fractionator-tower section, built by Wyatt's at Houston, was moved 11 miles in 5 hours on a special trailer rig. The rig was preceded by a police escort and a crew to raise trolley wires. The refinery is scheduled to go on stream early in 1954. Contractor is Foster Wheeler.

Directs Kerr-McGee Activities

McGee manages to relax despite busy schedule as executive vice president

AS executive vice president of Kerr-McGee Oil Industries, Inc., Dean A. McGee, at 49, is one of the industry's hardest working yet most relaxed executives.

The Oklahoma City headquarters of the still-expanding company is closed on Saturdays, but McGee will be in the office if he is in town. On normal days he doesn't leave until 6 p.m. or later. Friends quote his mother as saying he got in the work habit while still in school, when he held as many as four jobs at a time to finance an education in geology at the University of Kansas. He seldom got around to beginning his studies before midnight, she recalls.

One of the industry's youngest top executives when he took over the reins in 1942 at the age of 38, McGee has guided the firm through an expansion program involving pioneer operations in the offshore areas of the Gulf, unusual drilling operations in the Middle East, and, most recently, acquisition of a uranium mine and nearly 1,000,000 acres of uranium leases. This month the company will enter Alaska in a major exploratory program *(See "Alaska".)*

McGee served as instructor in engineering geology at Kansas for a year after his graduation, and then joined Phillips Petroleum Co. as a geologist in 1927. After 8 years of exploration work, he was made chief geologist for Phillips in 1935. Two years later he joined Kerlyn Oil Co. as vice president in charge of production and exploration, moving up to his present job in 1942. Kerlyn's name was changed to Kerr-McGee in 1946.

McGee greets visitors and discusses company problems with a deceptive casualness. Engineers and department heads who try to keep up with his work schedule say his ability to relax in almost any situation is the biggest factor enabling him to maintain the pace he sets.

Besides business, associates say, the only thing that will take him out of the office during the day will be a school program in which one of his two daughters is participating.

In addition to his Kerr-McGee interests, McGee is chairman of the board of Republic Supply Co., and president, director, or trustee of more than 30 other companies, institutions, or associations. These jobs include a newspaper, radio broadcasting company, bank, and research foundations.

During the 5½ years ending January 1, his company recorded a wildcat-success ratio of 29½ per cent, including 1 year in which half of the company's tests were discoveries. The best illustration of the man's personality is his answer to the question: "To what do you credit this wildcatting success?" In a brief, carefully phrased, and quietly spoken answer, he says it is due "mostly to luck" and to the "cycle of success and failure," with little explanation for the fact that Kerr-McGee consistently seems to be riding the high side of the cycle.

M. Scott Kraemer has been promoted from senior petroleum engineer for Stanolind Oil & Gas Co. at Tulsa to district engineer at Houston.

Fredric Moshier, formerly assistant to the director of the natural-gas department of the American Gas Association, has been appointed assistant secretary of the A.G.A.'s operating section.

Wolf van Engelhardt and **Walter L. M. Tunn** of the research laboratory of Gewerkschaft Elwerath, Hannover, Germany, are currently on a tour of the eastern half of the United States studying producing practices, especially secondary-recovery operations.

Richard C. Shelton, geologist for Ohio Oil Co., has been transferred from Fillmore, Calif., to Olympia, Wash.

John H. Brewer, assistant district superintendent of Magnolia Petroleum Co.'s Brownfield, Tex., district, has been promoted to district superintendent of the Louisiana-Gulf district. Other appointments include: **James A. Denney,** appointed assistant production foreman in the Chase district at Great Bend, Kans.; **Nat Coulter,** assistant foreman, promoted to production foreman in the Healdton, Okla., district; **Olvin H. Auld,** named drilling-tools foreman in the West Texas division; **J. E. Middleton,** promoted from assistant foreman to production foreman in the Pegasus district; **Edward L. Winterbauer, Jr.,** promoted from petroleum engineer to assistant production foreman in the Luling district; and **Willie Lee Jones,** named assistant production foreman in the Alice, Tex., district.

Robert W. Griffin, geologist for Stanolind Oil & Gas Co., has been transferred from Lubbock to Midland, Tex.

Carl R. Temple, district engineer for Sohio Petroleum Co. at Owensboro, Ky., has been promoted to district superintendent at Centralia, Ill.

L. E. Bolinger, district superintendent for Sinclair Pipe Line Co., has been transferred from Mexico, Mo., to Humboldt, Kans.

Joseph F. Mueller, roustabout for Stanolind Oil & Gas Co. at Midwest, Wyo., has been promoted to junior petroleum engineer at Rangely, Colo.

T. B. ARNOLD

T. Ben Arnold has been appointed superintendent of the Potwin, Kans., refinery of Vickers Petroleum Co., Inc., Wichita. Arnold has been chief engineer and manager of the refinery division of Southwestern Engineering Co., Los Angeles, the past 3 years, and was in charge of construction and installation of Vickers' new catalytic cracking unit that went on stream March 20, 1953. **A. M. Schreppfer,** vice president of manufacturing for Vickers, will continue to be in charge of over-all refinery operations.

PERSONALS

Frank Seely, who has been in charge of Mid-Continent field operations for Royal Oil & Gas Co., has been elected a vice president and director. He will retain his office in Tulsa.

S. H. Letteer, formerly joint interest advisor, has been appointed superintendent of production operations in the Tulsa production division of Gulf Oil Corp. **P. L. Gassett,** formerly manager of production in the Canadian district, has been transferred to Tulsa as superintendent of drilling operations. **W. H. Duley** has been promoted from assistant area superintendent to area superintendent in Kansas.

E. Nelson Salathe has been appointed senior procurement engineer in the purchasing division of the supply and distribution department of Standard Oil Co. (Ohio). He replaces **John N. H. Christman,** who has retired.

De France Clarke, Jr., has been appointed product manager for fine chemicals for Carbide & Carbon Chemicals Co., a division of Union Carbide & Carbon Corp.

C. H. Dodson, manager of the Chicago sales division of The Texas Co. since 1950, has been named assistant to the executive vice president, effective June 22.

Walter K. Link, chief geologist in the exploration section of Standard Oil Co. (N. J.), has been named exploration adviser to International Petroleum Co., Ltd., Standard subsidiary, effective August 1. Link, who has been with the Jersey Standard organization more than 27 years, will have his new headquarters in Coral Gables, Fla.

E. J. Gallagher has been appointed manager of the production department in the Canadian district of Gulf Oil Corp. He has been superintendent of operations at Tulsa since 1951. His staff includes: **F. D. Aaring,** in charge of the reservoir-engineering section, and **M. R. Dimple,** administrative assistant. **E. J. Baltrusaitis** has been appointed manager of the exploration department in the Canadian district. Baltrusaitis, who since 1951 has been area manager at Salt Lake City, will have **S. G. Pearson** as geophysical coordinator and assistant to the manager, and **O. A. Erdman** as chief geologist. **R. P. Lockwood,** who recently spent 5 months in the division office in Tulsa, has been named special assignments advisor to the general manager at Calgary. **R. J. Copeland,** formerly field supervisor in Canadian operations, has been named geophysical supervisor. Copeland has replaced **L. I. Brockway,** who has been transferred to the Gulf Research & Development Co. laboratory at Harmarville, Pa. **H. J. McGrew** has been named chief geophysicist.

L. J. Brewer has been elected a member of the board of directors of Esso Standard Oil, S.A. He will leave his

L. J. BREWER

W. I. PATRICK

position as manager of Cuba operations of the company to devote his full time as a director. **W. I. Patrick,** assistant manager of the company's operations in Cuba, has been named to succeed Brewer as manager and as vice president of Esso Standard Oil, S.A. **C. J. Griffin,** manager of the Esso Belot refinery, has been appointed assistant manager of Cuba operations, and **F. L. Fourrier,** assistant manager of the refinery, has been appointed to succeed Griffin as manager.

Dr. Paul D. Foote, executive vice president of Gulf Research & Development Co., has been awarded an honorary doctor of science degree by Carnegie Institute of Technology. Dr. Foote, also vice president of Gulf Oil Corp. and Gulf Refining Co., is the eighth person in the school's 53-year history to receive an honorary degree.

N. Dean Altemus of the reservoir-engineering section of Stanolind Oil & Gas Co., has been transferred from Lubbock, Tex., to Cody, Wyo.

J. W. Inkster has been appointed exploration manager for the Tulsa area of Shell Oil Co., succeeding **R. E. McAdams,** who has been named manager of the exploration department for the newly created Denver area. Inkster formerly was Houston area geologist.

M. S. Moore, driller for Triple E Drilling Co., has been transferred from Duncan to Seminole, Okla.

R. A. Broding has been elected vice president of Century Geophysical Corp., Tulsa, in charge of research and development. Since 1949 he has been research associate in the research and special instrumentation group of Magnolia Petroleum Co.

Carl W. Blakey has become a general partner of Manhart, Millison & Beebe, consulting geological and geophysical firm. He formerly was president of Petroleum Consultants, Inc., a seismic contracting company operating in the Mid-Continent and Rocky Mountain areas. Prior to joining Petroleum Consultants he was a seismic supervisor for Seismograph Service Corp.

Henry Harmon, Jr., technician at Deep Rock Oil Corp.'s research and development laboratories at Cushing, Okla., has been promoted to pilot-plant supervisor.

Burt Shullow, geologist for The California Co., has been transferred from Casper, Wyo., to New Orleans. **Max Hembree** has replaced Shullow at Casper.

Billy Guinn, geologist for The California Co. at Casper, Wyo., has been transferred to Craig, Colo.

Albert P. Haws, tool pusher for Penrod Drilling Co., has been transferred from Kermit to Aransas Pass, Tex.

Pierson M. Ralph, party chief for Geophysical Service, Inc., has been transferred from Greybull to Cody, Wyo.

Arnold S. Bunte, Roswell, N. M., division manager in the Permian basin for Vickers Petroleum Co., Inc., has been appointed associate professor of geology at the Colorado School of Mines, Golden, for the 1953-54 year. He joined Vickers in 1941 and also has served as chief geologist, chief engineer, and exploration manager.

William B. Oliver, Humble Oil & Refining Co., has been elected president of the Corpus Christ Geological Society. Other officers are: **W. G. Bealmear,** Baroid Well Logging Service, vice president; **Joe W. Lea,** Sun Oil Co., secretary; and **C. Wayne Holcomb,** Humble Oil & Refining Co., treasurer. Elected as councillors were **R. J. Gran-**

PERSONALS

berry, Core Laboratories, Inc., and **Harry D. Vaughn,** Lane-Wells Co. **W. H. Wallace, Jr.,** past president, was named a member of the executive committee.

Jan Oostermeyer, who recently retired as president of Shell Chemical Corp., has been elected to the board of directors of Food Machinery & Chemical Corp.

Frank E. Rehm, San Francisco, has retired as vice president of Shell Oil Co. after 37 years with the company. He plans to continue as secretary-treasurer of the Pacific Oil Institute.

Jack R. Fraser has been appointed chief petroleum engineer for Texas Eastern Production Corp., Houston. Fraser, who joined Texas Eastern in 1951 as district geologist, has recently served as division engineer. He formerly was division production geologist for Shell Oil Co. at Oklahoma City.

R. L. Rogers, Jr., district geologist, has been transferred to the new district exploration office of Murphy Corp., El Dorado, Ark., in Shreveport. The new office, to be occupied July 1, will assume functions formerly carried out by the Ark-La-Tex district in El Dorado. Others to be transferred to Shreveport include: **John B. Fatheree, Michael L. Kidda,** and **R. McKay Moore,** geologists.

W. T. Nance, development engineer for Shell Oil Co. in Houston, has been transferred to Los Angeles as a senior mechanical engineer. **J. C. Taylor,** development engineer, has been transferred from Los Angeles to the division office at Long Beach. **R. L. Blocher,** geologist, has been transferred from Ventura, Calif., to the company's new Alaska division office at Seattle. **M. V. Kirk** of the Bakersfield division, and **Q. C. Hebrew,** formerly in Salt Lake City, both have been transferred to Seattle. Other recent Shell changes include: **H. J. Buddenhagen,** who returned from The Hague as senior geologist at Los Angeles; **H. C. Curry,** also back from The Hague as district geologist at Casper, Wyo.; **L. B. McIntyre,** promoted from junior geologist at Grand Junction, Colo., to geologist at Casper.

Jacques W. Zoller has been appointed division exploitation engineer in North Texas for Shell Oil Co. He formerly was area exploitation engineer in Tulsa. He has been replaced by **W. E. Buck.**

J. C. Hamilton, E. P. Farmer, and **P. J. Erickson** have been named vice presidents of Arkansas-Louisiana Gas Co., which recently separated from Arkansas Fuel Oil Co. to comply with SEC regulations. In addition, Erickson will serve as chief engineer.

John Christopher has been appointed a petroleum engineer for Terry Drilling in Los Angeles. He formerly was a consultant in Cisco, Tex.

J. O. Sue has been named assistant manager of the production department of Humble Oil & Refining Co. He will be responsible for natural-gas sales, transportation, processing, and operation of gasoline plants. **Bowman Thomas** has been appointed assistant department manager in charge of all staff activities on proration and unitization work. **R. E. Bridges** has been given a 1-year assignment as assistant manager of the production department dealing with operating problems. **R. J. Schilthuis** has been named superintendent of the gas division of the department. **J. H. Galloway,** acting production department assistant manager, has returned to his regular duties as assistant superintendent of the West Texas division.

E. F. Hutchinson, senior technologist in the head office of Shell Oil Co., has been transferred to the Wood River, Ill., refinery as manager of the compounding department. **F. F. Farley,** chief research chemist at Wood River, has been transferred to the Martinez, Calif., refinery as chief research chemist. **H. W. Anderson,** chief research chemist at Martinez, has been transferred to Wood River in the same capacity. **R. A. Burdett,** assistant chief research chemist at Wood River, has been appointed chief research physicist there.

H. K. Sutherland, formerly assistant director of Shell Development Co.'s Modesto, Calif., laboratory has been transferred to New York. He will assist the president in matters relating to liaison in the agricultural research division. **C. P. Brewer,** research supervisor in the petroleum refining department of the Emeryville, Calif., research center, has been transferred to New York to assist in liaison with the chemical-research division. **A. S. Lehmann,** in addition to his duties as technical representative in the company's licensing division in New York, will aid the president in regard to the Emeryville development and engineering division.

DEATHS

H. A. (Lon) Melat, 95, formerly production superintendent for Gulf Oil Corp. and Gulf Refining Co., died June 9 in McAllen, Tex. He was a native of Venango County, Pennsylvania, and came to the Mid-Continent area when the Spindletop field was opened in 1901. He helped develop the properties of the Star Oil Co., which were later absorbed by the J. M. Guffey Petroleum Co. He retired in 1933 after 30 years as a Gulf employe.

George M. Daley, 50, purchasing agent for Esso Standard Oil Co., died June 10 at his home in Colonia, N. J.

Robert Murray Campbell, 57, tax manager for Consolidated Natural Gas Co., died in New York June 13.

John A. Fisher, 73, retired driller of Peck, Kans., died June 14 in Wichita.

W. P. Z. German, 76, chief legal counsel for Skelly Oil Co. since the firm was organized in 1919, died June 14 in Tulsa. He is credited with shaping Oklahoma's first oil conservation laws. He was a board member or officer in the American Petroleum Institute, Mid-Continent Oil and Gas Association, and the Osage Oil and Gas Lessees Association, and was chairman of the legal committee of the Oklahoma-Kansas division of the Mid-Continent Oil and Gas Association.

R. Leslie Beattie, 62, vice president and general manager of Canadian operations for International Nickel Co. of Canada, Ltd., died June 10 in Toronto, Ont.

John Oren Spelts, 59, Long Beach, a partner in Cockriel & Spelts Petroleum Co., died recently while visiting in Idaho Falls, Idaho.

THE GULF COAST TODAY

A SPECIAL SECTION OF THE OIL AND GAS JOURNAL

Picture-Touring U.S. Oil's Liveliest Domain

FLORIDA THROUGH TEXAS . . . **. . . EXPLORATION THROUGH PETROCHEMICALS**

GRAVITY SURVEYING in the marshes of the Gulf Coast is best accomplished by using helicopters. Here a surveyor on a 14-ft. portable tower is in a position to "shoot in" a helicopter when it lands for reading.

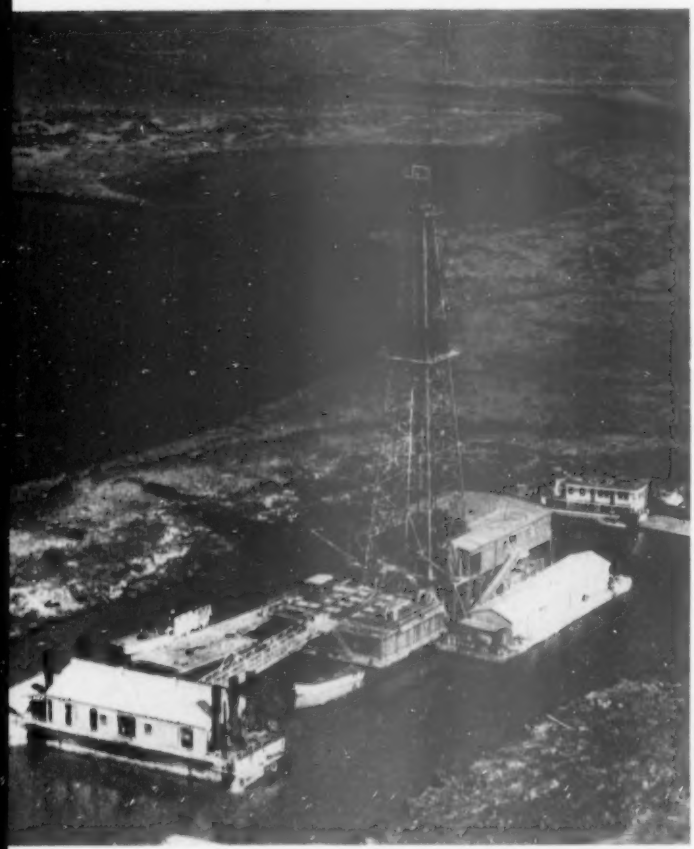
MARSH BUGGIES are used for exploration work in those portions of the Gulf Coast where both land and water traverses are made during a normal day's work. Here is one of the latest type of marsh buggies coming out of a bayou. It travels on land or on water and has a speed of at least 30 m.p.h.

OFFSHORE SHOOTING in the Gulf of Mexico has become an important part of Gulf Coast exploration work. Here an explosion of dynamite sends a column of water skyward during a seismic survey.

SEISMIC SURVEYING in the Gulf Coast encounters all imaginable conditions. Here the man with the pole is planting a geophone in the muck at the bottom of a bayou. He is standing on an air boat which can be used in very shallow water and with sufficient momentum can "jump" narrow strips of land.

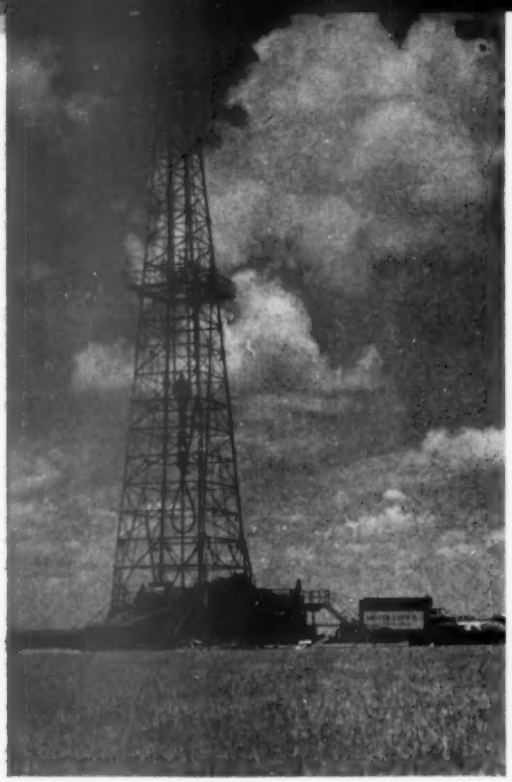
HACKBERRY, LA.'S, Black Lake field is location of this Stanolind Oil & Gas Co. rig.

SOUTH LOUISIANA'S drilling operations require movement of equipment and supplies over water routes into inaccessible locations such as this Humble Oil & Refining Co. operation. Last year Humble reported average cost of 1,102 wells it drilled amounted to $106,500 per well.



PLAQUEMINES PARISH, LOUISIANA. The difficult terrain encountered in the delta country may be seen at this well in Lake Washington field, for Freeport Sulphur Co. Freeport is an oil, as well as sulfur, producer.

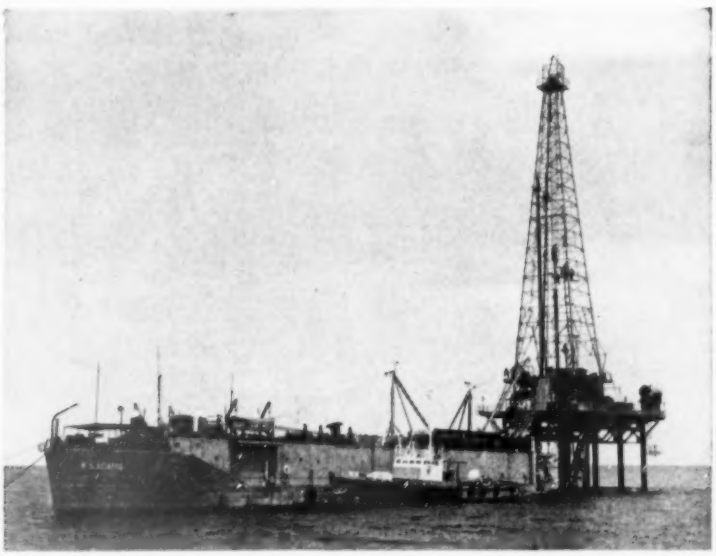
THE TEXAS CO.'S "RHODES" is one of the largest barge-mounted diesel-powered rigs. This location is Lake Barre, Terrebonne Parish, Louisiana. The Rhodes is equipped to drill to a depth of 20,000 ft.



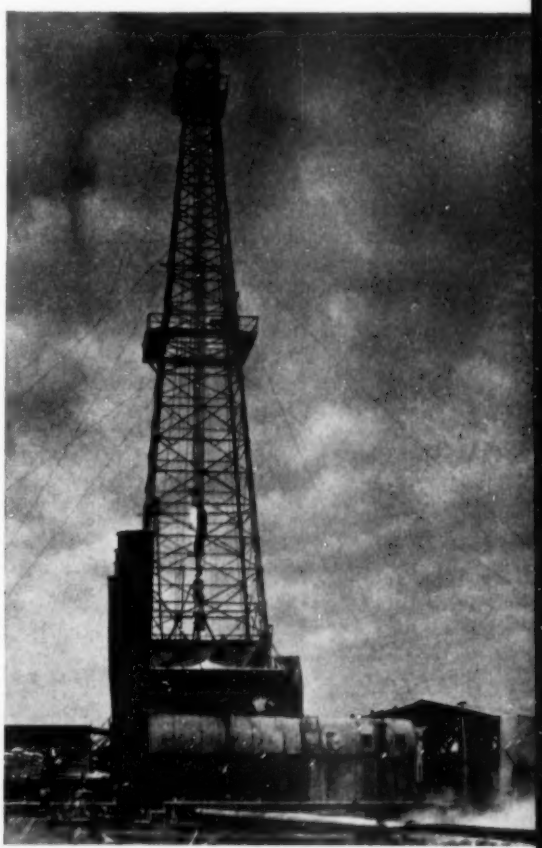
STEAM RIG working for Humble Oil & Refining Co. Last year, Humble completed 15 or more wells in four Gulf Coast fields.

KERMAC NO. 3 of the fleet of drilling barges operated by Kerr-McGee Oil Industries, Inc., is shown here submerged on a location in Breton Sound, Louisiana, east of the Mississippi Delta.

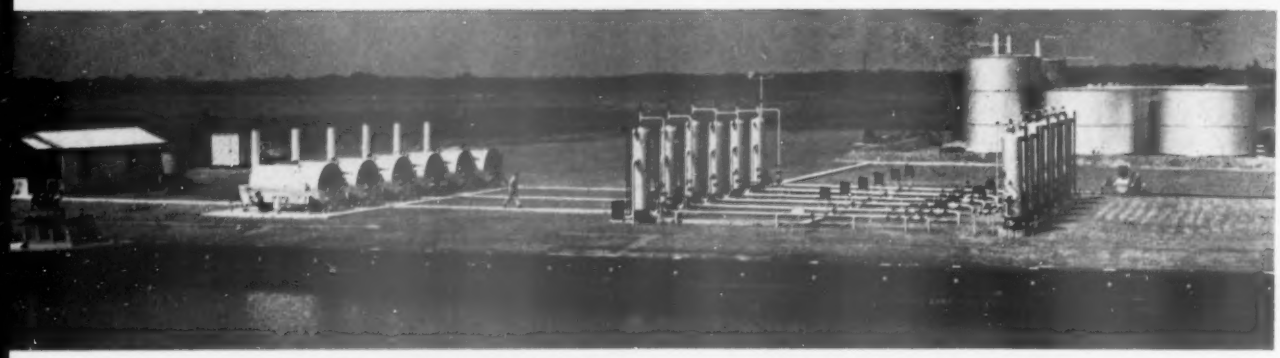
DRILLING . . . The Gulf Coast's Districts 2 and 3 cut 16.9 million feet of hole, and Districts 1 and 4 drilled 10.8 million feet, for total of 27.7 million feet last year. West Texas drilled 29.3 million feet. Oklahoma drilled 21.6 million feet. These were the leaders in total footage drilled.



PHILLIPS PETROLEUM added to its natural-gas reserves with recent completion of this well drilled in 40 ft. of water in the Gulf of Mexico, 9 miles off the coast of Vermilion Parish, Louisiana. The well has nine other gas-bearing sands.



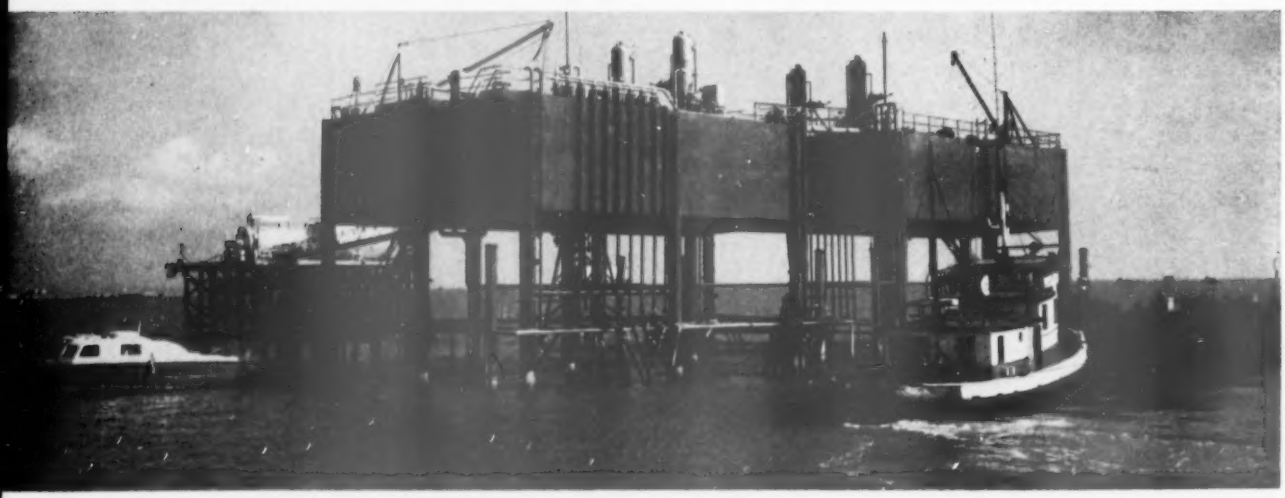
DRILLED 2,705 FT. IN 8 HOURS. Well of Union Sulphur & Oil Co. covering interval 1,880-4,586 ft. (338 ft. per hour). Well drilled 10,020 ft. in 11 days.



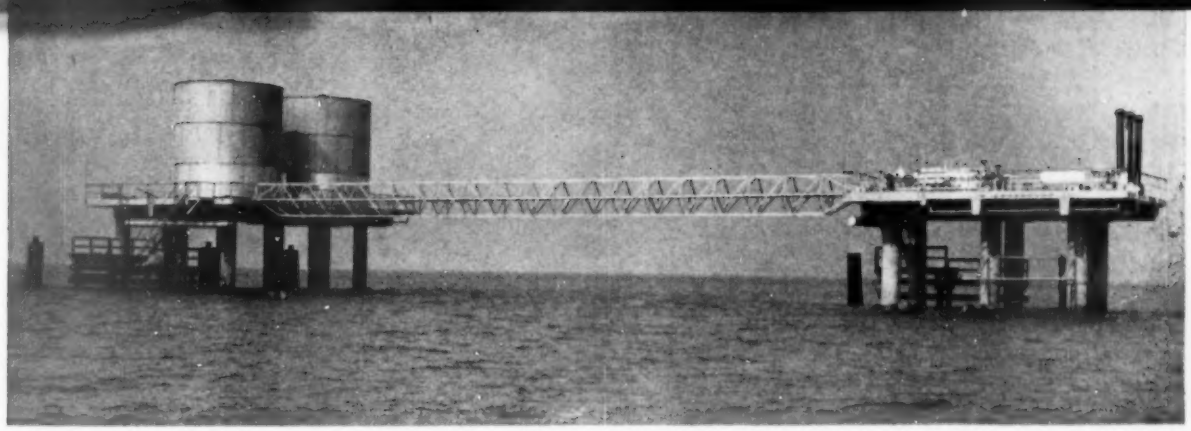
OIL AND GAS.—Far down in the marshlands of South Louisiana, in Terrebonne Parish, this battery of heaters and separators process gas produced in the Lirette and Bay Baptiste fields. Operator is Union Producing Co., production subsidiary of United Gas Corp.

CLOSED-TYPE WATER FLOOD at Hackberry field, Cameron Parish, Louisiana, operated by Stanolind Oil & Gas Co. This is one of the deepest water-flood projects—the oil sands being below 10,000 ft.

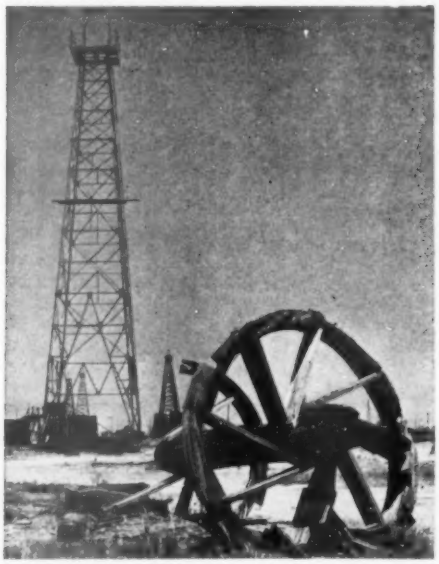
PRODUCTION . . . In the Gulf Coast (first of year) are 3.3 billion barrels crude reserves, Southwest Texas district, 1.4 billion barrels. Detailed production figures for the Gulf Coast areas, and interesting leases, are given in article this issue commencing page 184.



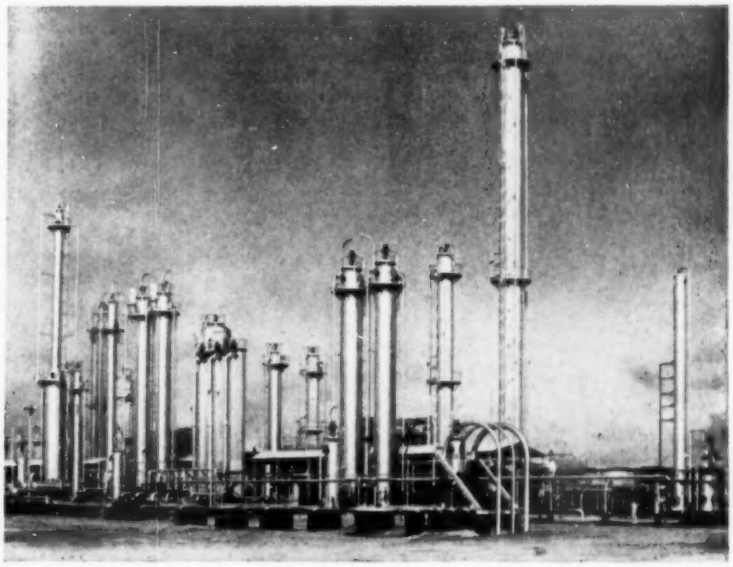
TANK BATTERY-HEATER TREATER PLATFORM located in Redfish Bay, 12 miles out from Corpus Christi. Crude from 11 Atlantic Refining Co. wells flows into this battery and is then moved by barge across the bay to Atlantic Pipe Line Co.'s Harbor Island terminal for transshipment by tanker.



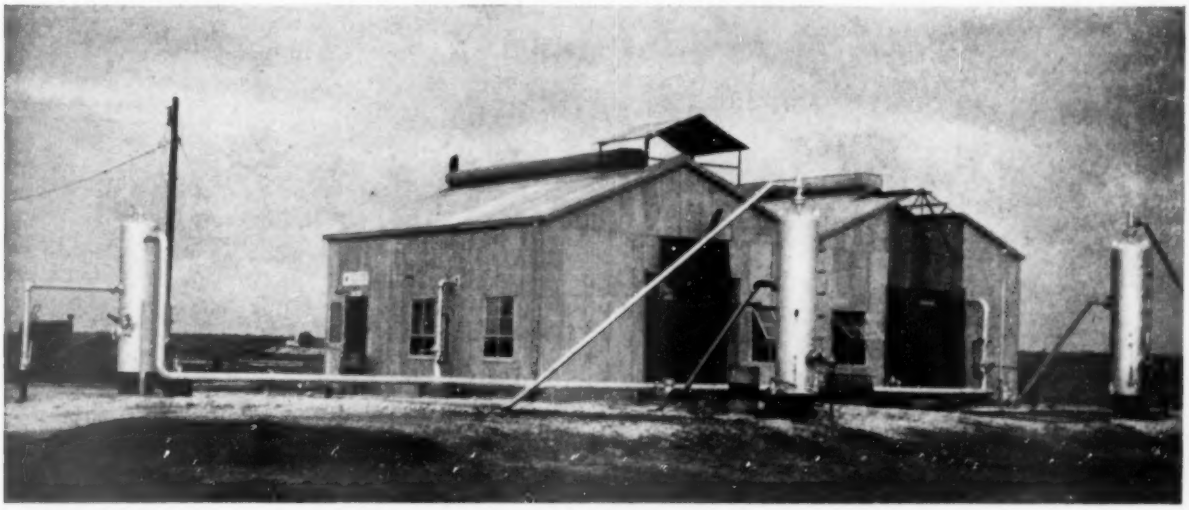
PAN AMERICAN PRODUCTION'S low-temperature separation and storage platforms, Lake Sand field, St. Mary Parish, Louisiana, (in construction). Prestressed concrete piling and prefabricated concrete platforms were used. Water depth is 15 ft., platform height is 16 ft. above water. The separator platform supports three heaters, two low-temperature separation units, five flow lines complete with a manifold, gas meter runs, two electric plants, maintenance house, radio and radio mast.



PAST AND PRESENT . . . Discarded wooden bull wheel in foreground, modern individual pumpers in background (Spindletop field).

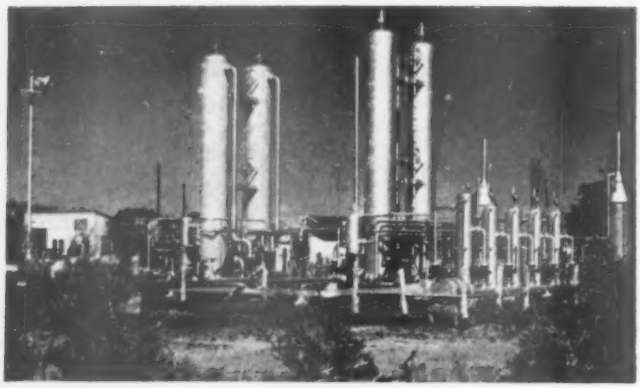


SEELIGSON PLANT, located near Premont, Jim Wells County, Texas. The plant was designed to handle 70,000 M.c.f. per day of casing-head gas and 150,000 M.c.f. per day of cycle gas and at present produces natural gasoline, iso and normal butane, propane, mineral seal oil, and kerosine.



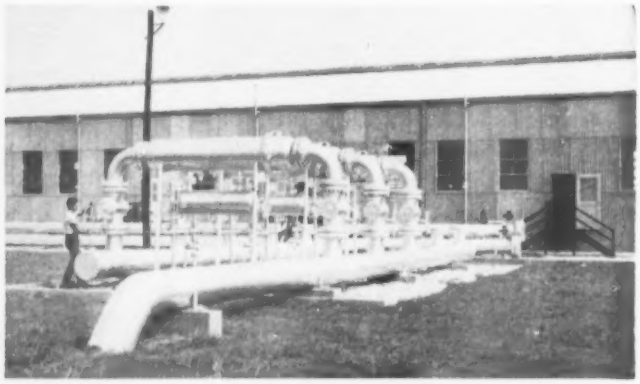
COMPRESSORS pump produced gas from Texas Co. leases at Chocolate Bayou, Brazoria County, to Phillips Petroleum's Chocolate Bayou gasoline plant.

NEW GULF COAST PIPE LINE of Texas Eastern Transmission Corp. will be in operation when construction of the 24-in. gas carrier is completed. Route will extend 310 miles, from Provident City, Tex., to Castor, La.



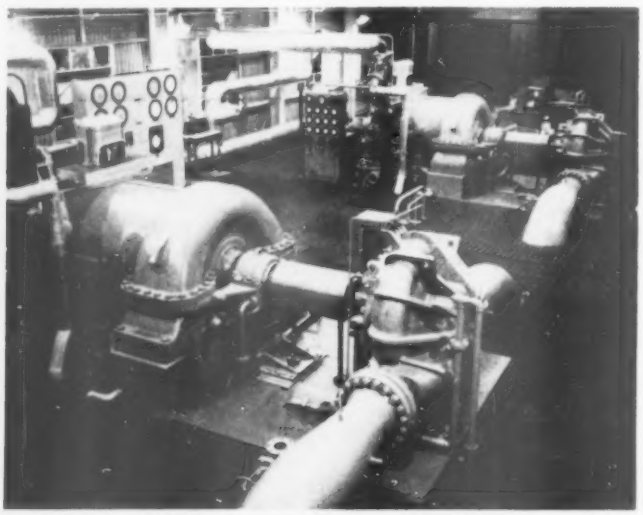
DEHYDRATION PLANT of Tennessee Gas Transmission Co. at San Salvador, Tex., handles some 100,000,000 cu. ft. of gas daily. Dehydration towers are of the solid-desiccant type.

BOILERS AND STACKS at station No. 7, Tylertown, Miss., of Transcontinental Gas Pipe Line Corp. The boilers are rated at 43,000 lb. per hour. They furnish power for steam-turbine-driven centrifugal compressors of 14,830 combined horsepower.

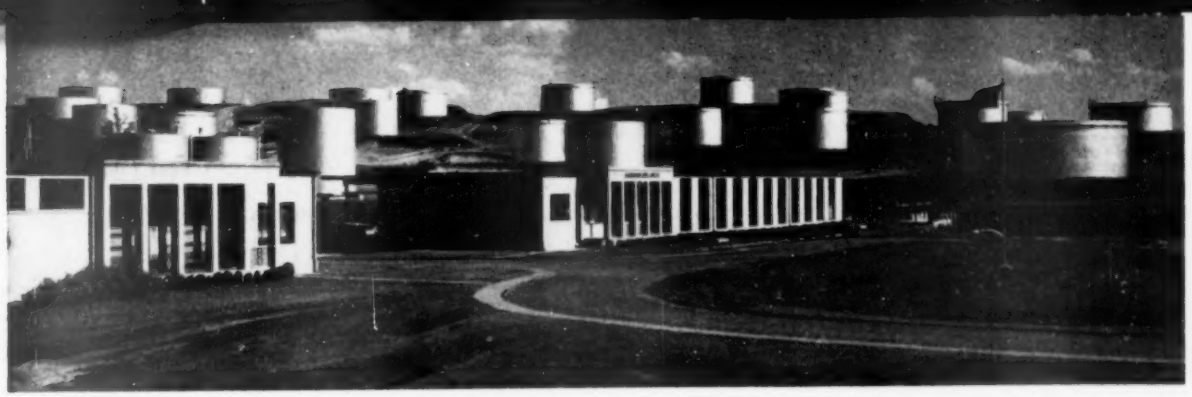


COMPRESSOR STATION of Texas Eastern Transmission Corp. near Hankamer, Tex. Horizontal gas scrubbers are in the foreground. Texas Eastern operates 36 compressor stations, delivering over 1.2 billion cubic feet of natural gas daily through 4,200 miles of pipe lines.

LAFAYETTE COMPRESSOR STATION of United Gas Pipe Line Co. is located near Lafayette, La. The station is one of eight new compressor installations completed during 1952 as part of a 3-year $250,000,000 expansion program.

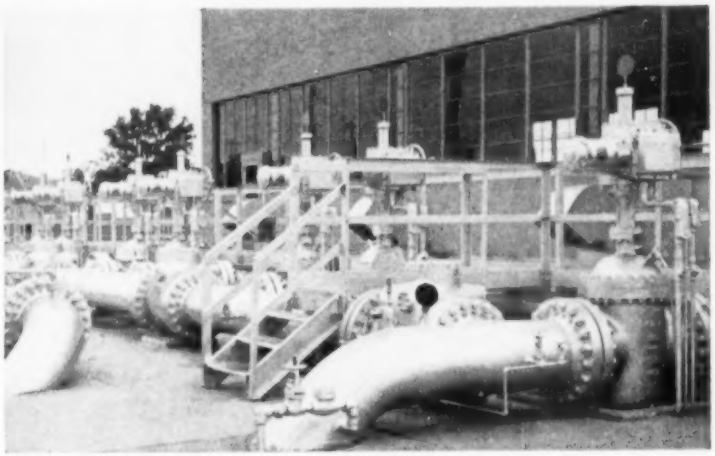


EUNICE, LA., STATION of Transcontinental Gas Pipe Line Corp. contains three steam-turbine-driven centrifugal compressors which have a total horsepower of 13,040. Incoming station pressure is 475 psi.; outgoing is 800 psi.

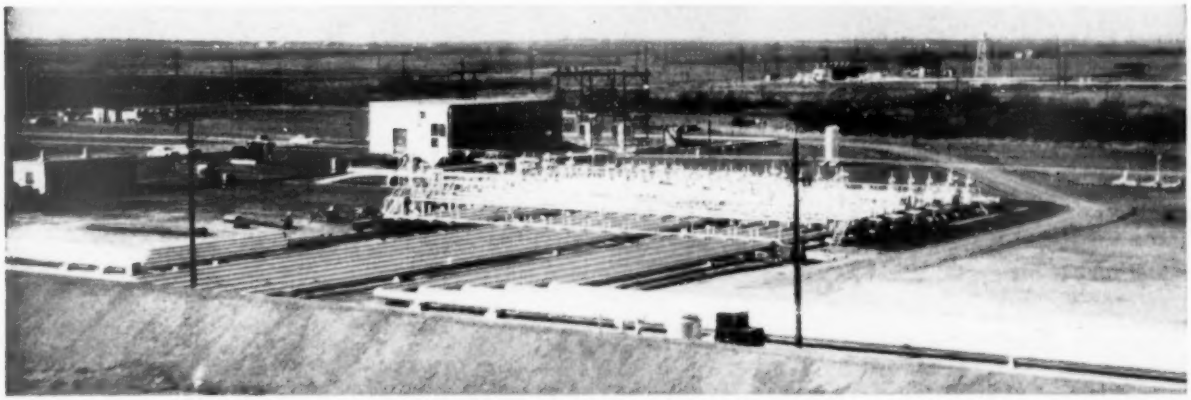


PRODUCTS MOVE from Plantation Pipe Line Co.'s Baton Rouge terminal through parallel 18 and 12-in. main lines to this terminal station at Bremen, Ga. Plantation's system extends northward from here to Greensboro, N. C., and to Chattanooga and Knoxville.

THE GULF COAST area contains the most concentrated petroleum operations to be found in the United States. A number of crude-oil pipe lines come into the region to feed its big refineries. Likewise, a number of products lines help funnel finished products to places of use. Large volumes of gas are pipe lined from producing wells to the area's industrial plants and to carriers terminating in the Mid-west, East, and Northeast.

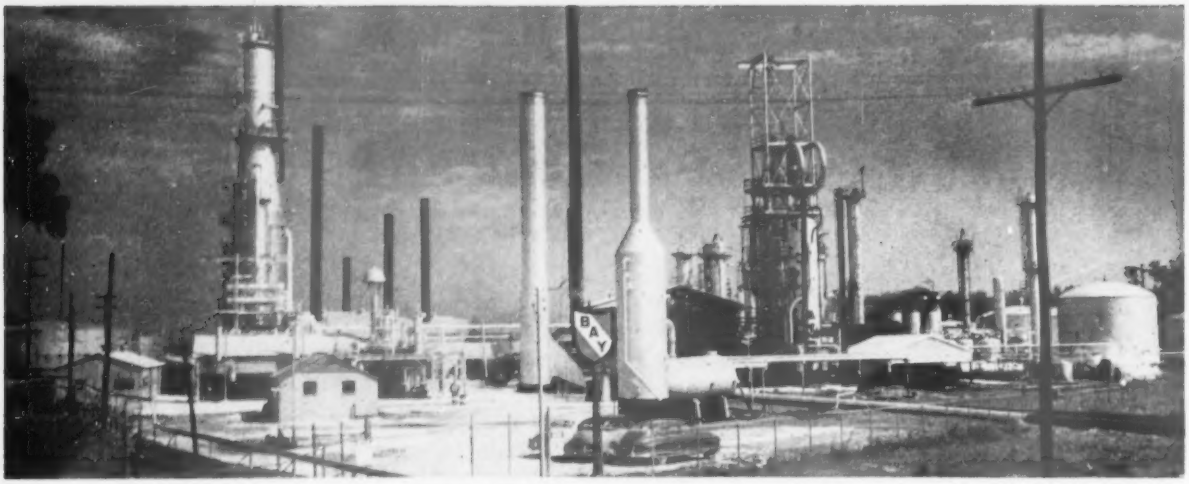


NEW CRUDE CARRIER is this 457-mile, 24-in. line of Rancho Pipe Line System. The 210,000-bbl. per day line runs from McCamey in West Texas to the Houston Ship Channel area.

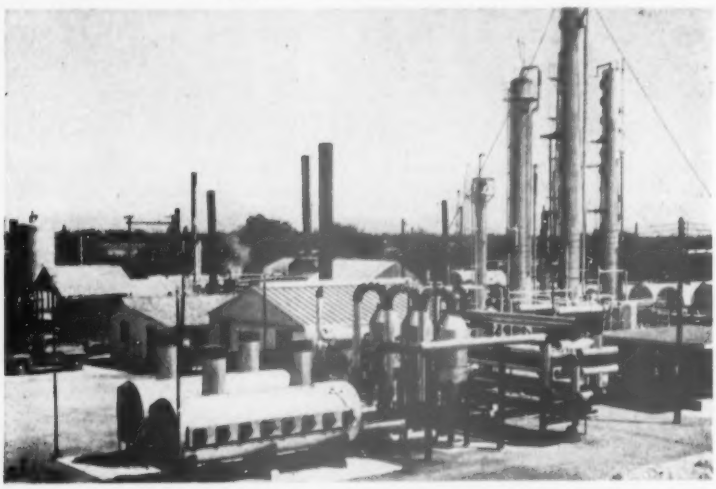


CRUDE FOR GULF COAST is started on its way at this Colorado City, Tex., terminal of West Texas Gulf Pipe Line Co.'s new 26-in. line. This line, which has an ultimate capacity of 440,000 bbl. of crude per day, is the largest crude-oil pipe line in North America.

OFFSHORE OIL, as well as oil produced on the Gulf Coast and some crude from the West Texas-New Mexico area, is transshipped out of the Atlantic Pipe Line Co.'s modern terminal at Harbor Island, near Aransas Pass, Tex. More than $1,000,000 has been spent in the last year on improvements for this terminus.



CRUDE CAPACITY of this Chalmette, La., refinery of Bay Petroleum Corp. is 20,000 bbl. per day. The fluid catalytic cracking section is shown at left, feed preparation unit is in center, and polymer and L.P.G. units are at right. The refinery operated under the name of Chalmette Petroleum Corp. before it was purchased and merged with Bay. Capacity has since been upped from 8,000 bbl. per day.

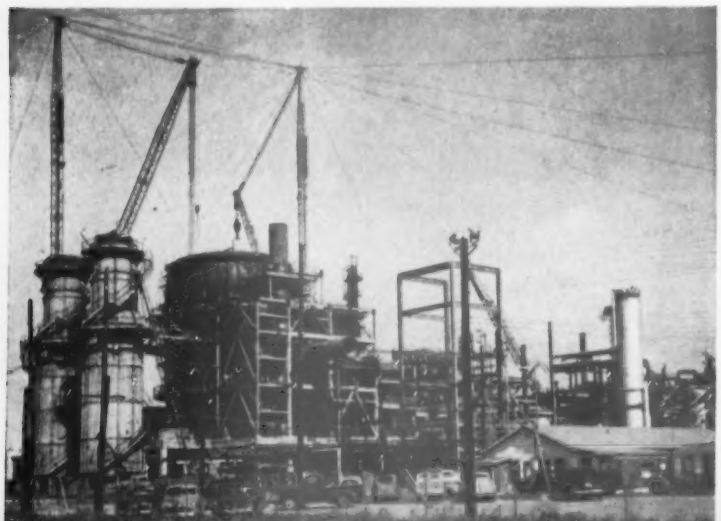


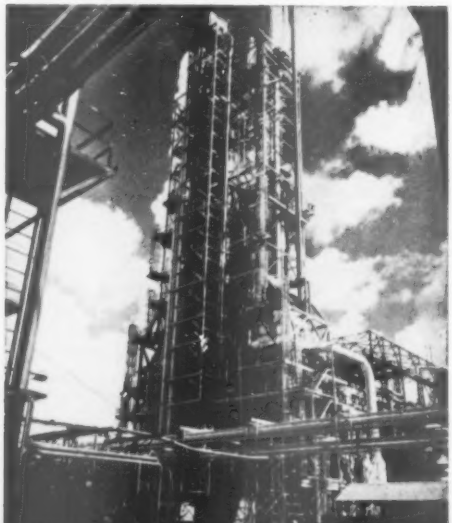
FIRST CATFORMER to be installed on a commercial basis is this catalytic reforming unit at McBride Refining Co.'s La Blanca, Tex., plant. The 750-bbl. unit, licensed by Atlantic Refining Co., upgrades naphtha from two different crudes.

FLUID CAT CRACKER construction symbolizes Sinclair Refining Co.'s expansion at its Houston refinery. Crude throughput will be upped from 90,000 to 125,000 bbl. per day when construction is completed this fall.

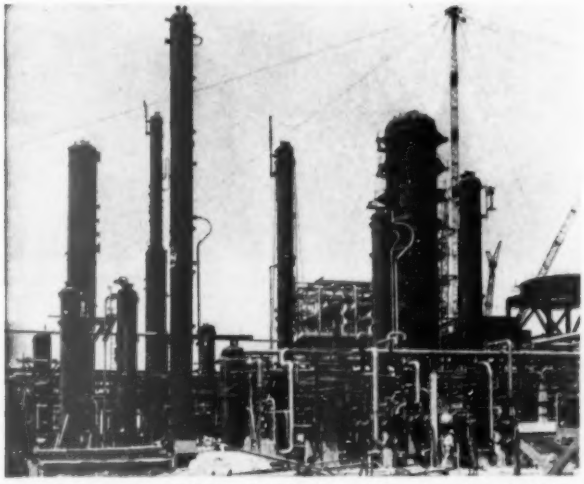
Approximately one third of the nation's refining capacity is found along the Texas-Louisiana Gulf Coast. Nearly one half of the total United States installed capacity for catalytic cracking and catalytic reforming operations may be found in this area. Some 30 per cent of country's polymer gasoline is produced here. About one third of the nation's lube-oil-production capacity is installed in this region.

THESE TWIN AIR-LIFT type Thermofor Catalytic Cracking units at Magnolia Petroleum Co.'s Beaumont refinery were the first of their type to be placed in operation. A third unit has been placed on stream at the 175,000-bbl.-per-day refinery, and plans call for the construction of a 17,000-bbl.-per-day Thermofor Catalytic Reforming unit.

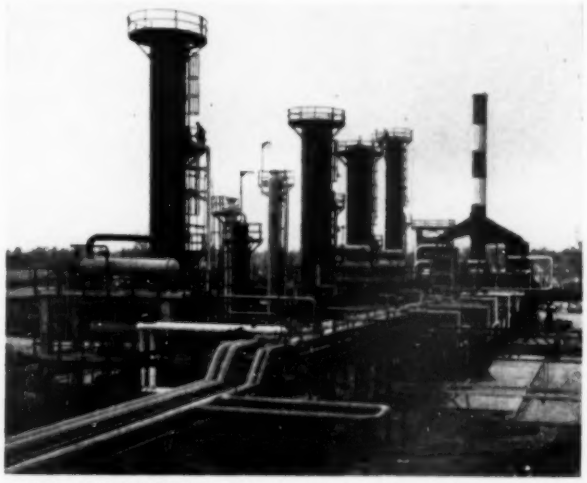




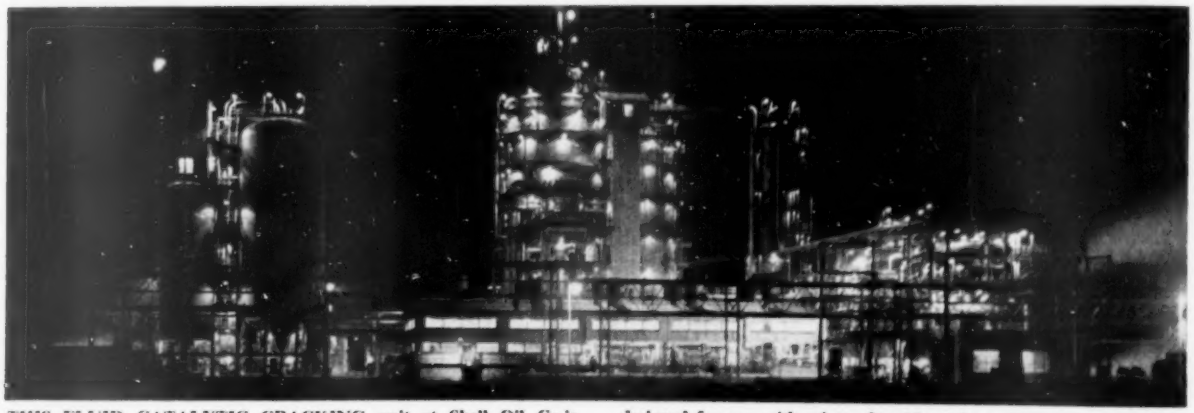
ONE OF NATION'S LARGEST refineries is this plant of Gulf Oil Corp. in Port Arthur. Daily crude charge capacity of this complete and well integrated refinery is 245,000 bbl. per day. At left are the tanker-loading docks. General office building is at lower right. Research and laboratory facilities are at center. Processing units are in right background.



TOTAL CAT CRACKING CAPACITY of Pan American Refining Corp.'s Texas City refinery will reach 70,000 bbl. per day when the second fluid catalytic cracking unit is placed on stream this summer. The Model IV unit will process 30,000 bbl. per day of virgin gas oil.



THIS PLATFORMING unit is used to prepare charge stock for the world's first Udex unit. The 7,000-bbl. per day Platformer is an integral part of Eastern States Petroleum Co.'s 48,000-bbl. per day Houston refinery. Udex unit extracts 500 bbl. per day of aromatics.

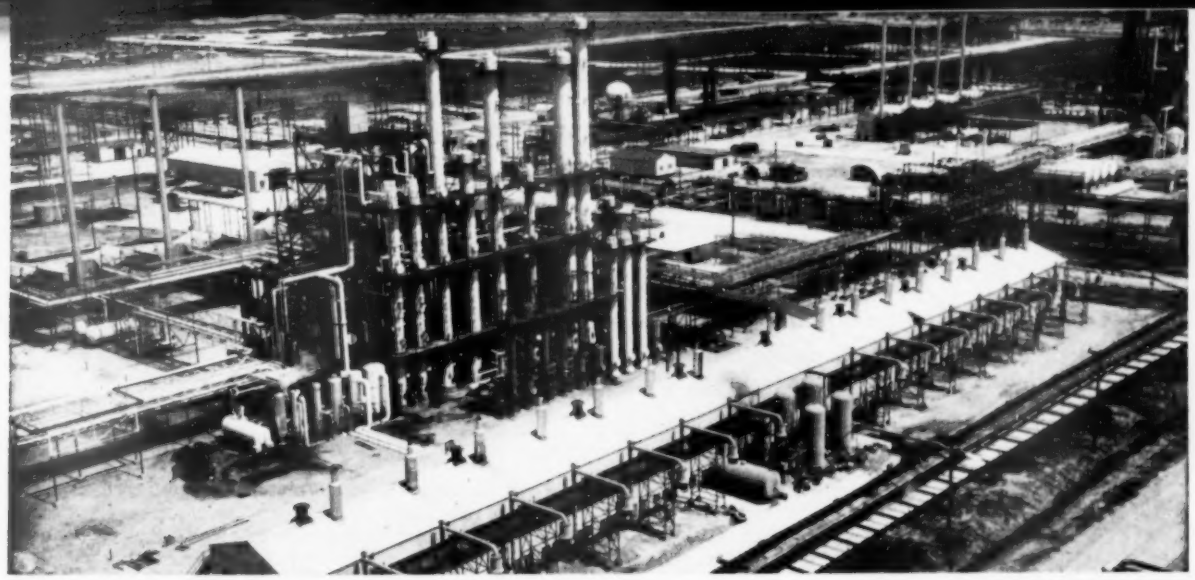


THIS FLUID CATALYTIC CRACKING unit at Shell Oil Co.'s 115,000-bbl. per day Houston refinery was the first unit of its kind designed for use with microspheroid catalyst. From left to right are catalyst storage bins, fractionator, and pump house.

PETROCHEMICAL PLANT of Shell Chemical Corp., located adjacent to Shell Oil Co.'s Houston refinery, processes refinery gases into a number of end products. One of the largest petrochemical plants in the country, this plant was the first to produce synthetic glycerin and butadiene in commercial quantities.

NATURAL GAS, propane, and butane are used by Celanese Corp. of America to produce a complete series of petrochemicals at its Bishop, Tex., plant. Using direct oxidation by air as its prime implement, Celanese ends up with such products as acetic acid, acetone, methanol, butanols, propylene glycol, propylene oxide, and formaldehyde.

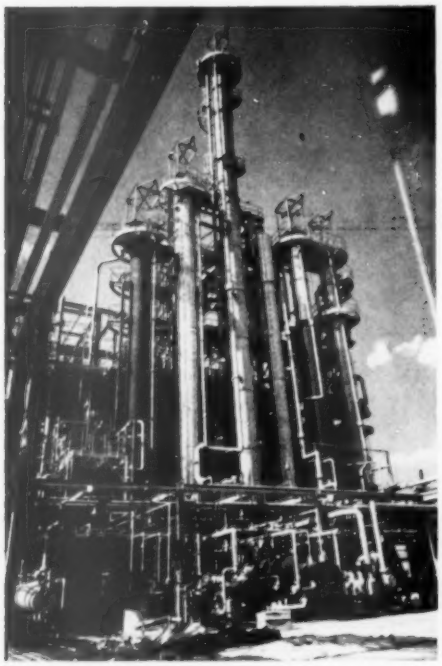
STYRENE MONOMER is produced as one of the principal products at Monsanto Chemical Co.'s Texas City, Tex., plant. Other chemicals derived from natural gas are also produced here. Monsanto recently completed a plant for production of acetylene which will be used in synthesis of other chemicals.



LIGHT HYDROCARBON unit at the Texas Division of Dow Chemical Co.'s Freeport, Tex., petrochemical plant has compressor house in foreground and fractionating columns at left center. Ethylene and propylene are produced in this unit as intermediates for the manufacture of glycols and chlorinated hydrocarbons.

GULF COAST PETROCHEMICALS constitute a high percentage of the nation's output. Demand for raw materials in the Houston-Texas City and Beaumont-Port Arthur-Orange areas is so great that pipe lines are used to transport materials that are usually shipped in bottles and cylinders. There are ethylene, chlorine, L.P.G., and other lines crisscrossing the areas.

BIG PETROCHEMICAL EXPANSION is underway by Carbide & Carbon Chemicals Co., with final cost of projects totaling some $100,000,000. This night view shows the Texas City, Tex., plant which is currently being expanded. A new plant is being built at Seadrift, on the Texas Gulf Coast.



NATURAL GAS is used at this Orange, Tex., plant of E. I. du Pont de Nemours & Co., Inc., for synthesis of nylon intermediates, methanol, and polyethylene resin.

THIS PYRIDINE PLANT, located at Adams Terminal on the Houston Ship Channel, has been recently completed by Phillips Chemical Co. It is designed to produce 2,000,000 lb. per year of methylvinylpyridine and 1,000,000 lb. per year of other pyridine products.

TEMPERATURE SURVEYS . . .

. . . to locate zone of lost circulation

Gulf Coast tests show method to be adequate, though not capable of extremely close definition of loss zones. Location of losses to within even a 50-ft. interval is believed sufficiently accurate for most squeezing operations.

by W. C. Goins, Jr.
and
D. D. Dawson, Jr.

IN many serious instances of loss of circulation the use of fibrous, flake, and granular sealing materials fails to effect a seal. When this happens it is often necessary to resort to one of the several "squeezing" techiques such as cement, time-setting clay cement, bentonite-diesel oil squeeze, etc. Effective use of these methods requires that the zone of loss of circulation in the well be located. This article discusses the use of a temperature-survey method for locating losses which the authors have found to be effective.

The practice of using temperature surveys to locate zones of lost circulation is not new [1] [2] but the early attempts were so wasteful of drilling mud that the method was seldom used. Cannon [2] described a procedure wherein a volume of mud equal to the volume of the hole was displaced into the formation. This often required from 500 to 1,000 bbl. of mud, which with high mud densities, may cost up to $15 per barrel. Careful engineering of the technique has resulted in a method which usually requires only 50 to 100 bbl. of mud. Other instruments for locating losses have the disadvantages of being subject to clogging by loose shale or sealing materials, and are usually difficult to obtain on short notice. Temperature surveying instruments have little tendency to clog and are readily available at points near drilling wells.

General Principles

When the mud is circulating it assumes a temperature gradient which differs from the formation-temperature gradient. The mud-temperature gradient is dependent upon several factors such as hole size, circulating rate, formation gradient, and type of mud being circulated. However, the value of the gradient is not as important as the fact that the mud temperature does increase with depth. When loss of circulation occurs and mud is displaced from the surface, the mud below the point of loss is undisturbed, whereas the mud above the point is moved down the hole. This causes a decrease in temperature down to the point of loss. Below the loss the mud temperature will be unchanged.

If the volume of mud displaced is equal to that contained in about 1,000 ft. of hole, the decrease in temperature of the fluid down to the loss will amount to several degrees and this is sufficient to be detected by ordinary temperature-surveying instruments. The sharp displacement of the gradient, or temperature "break," that occurs at the point of loss is particularly evident. Fig. 1 is an idealized version of the mud temperatures in a well under these conditions.

Field Methods

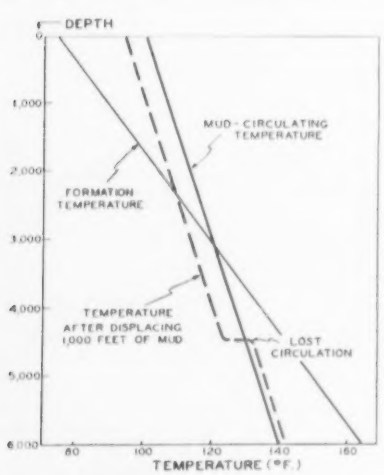
In general, the following procedure is recommended for using this method to locate a point of loss.

A. If hole is standing full of mud:

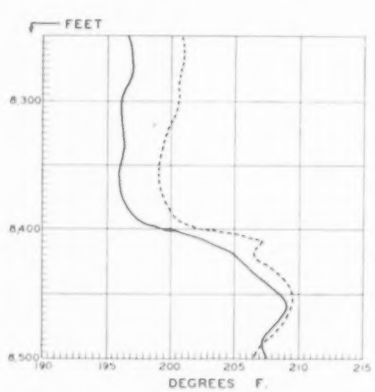
1. Run a temperature survey, while going in the hole, at 100 to 150 ft. per minute, starting to record at least 500 ft. before bottom of last string of casing. Record continuously to bottom. If this is impossible due to hole conditions, then log as far as the instrument will go. Successive runs should be made at the same logging rate.

2. Log in an upward direction over the same interval at the same rate of speed.

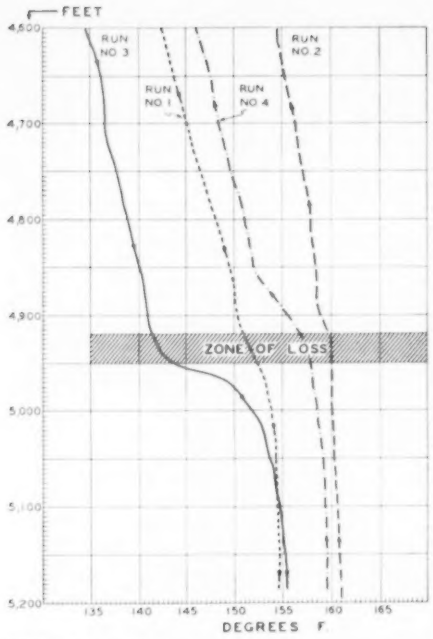
3. Close well in and pump mud into formation. The amount of mud displaced is somewhat optional. It should be governed to a certain extent by the results of the first runs. Nor-



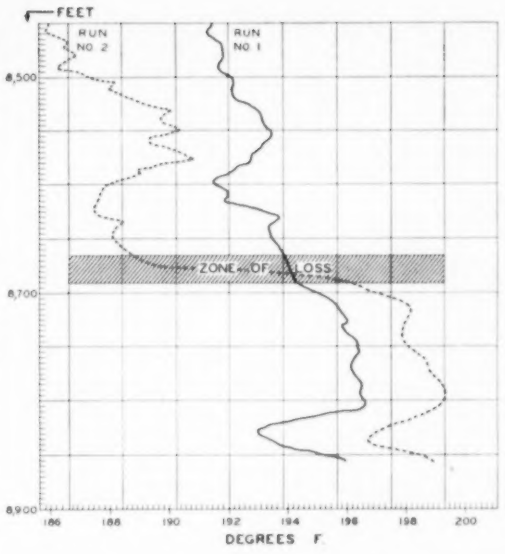
TEMPERATURE SURVEY to locate lost circulation, idealized conditions. Fig. 1.



TEMPERATURE SURVEY to locate lost circulation, Miriam Partlow 1 well, South Dayton, Tex., June 19, 1952. Graph above is continuation of graph at left. Fig. 2.



ZONE OF LOSS is clearly shown by temperature survey in Miriam Partlow 1 well, June 4, 1952. Fig. 3.



TEMPERATURE SURVEY shows zone of lost circulation in U. S. of America "W" 1 well, Pearl River County, Mississippi. Fig. 4.

mally, about 1,000 ft. of mud in the fluid column should be displaced into the formation. Formation temperature gradients on the Gulf Coast range between 12° and 22° per 1,000 ft., so this amount of fluid displacement should be ample. In other areas enough mud should be displaced to give a corresponding temperature change at the point of loss.

4. Repeat steps 1 and 2. This will usually give enough information to pin point the loss. If additional runs are necessary, mud should be pumped in as before.

B. If the hole does not stand full:

1. Proceed in the same manner as in the case where the hole stands full except that temperature logging should begin at the surface on the first run in order to locate the mud level.

2. After the first down and up runs are completed, the hole should, if possible, be filled with water until it stands full; then the fluid column should be displaced downward as before for a distance of 1,000 ft.

3. It is usually desirable to log back up to surface when coming out of the hole after the survey is completed as an additional check on the amount of water pumped in and of the fluid level. Usually, the fluid level and the water-mud contact can be located and the total amount of mud displaced can then be calculated.

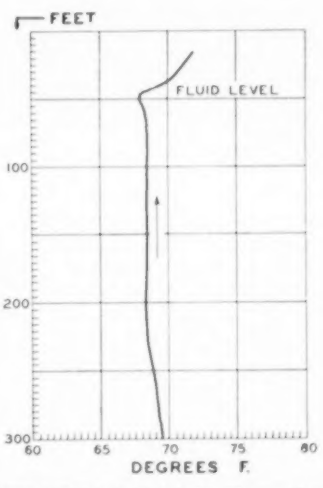
4. If the hole cannot be filled with water, then the fluid level should be determined before and after attempts to fill the hole. In this way it is possible to make certain that enough mud has been displaced in the hole to give a sharp break in gradient.

Interpretation of Logs

When interpreting logs it is best to compare downward runs and upward runs separately. A convenient technique is to lay the film negative from the run after mud displacement, on top of a print of the corresponding run before displacement. Because there is a lag in response of the instrument to temperature changes, the upward and downward runs will be slightly different in recorded temperature and in the appearance of the break at the point of loss. The top of the break in temperature gradient found on the downward runs is taken as indicating the zone of loss, and on the upward runs the lower part of the break is the marker.

Fig. 2 shows two downward logs from a Gulf Coast well where 72 bbl. of mud were pumped in between runs. The zone of loss appears at about 4,935-50 ft. In this instance the loss could have been located without displacing additional mud as a break in temperature occurred as a result of the initial loss. However, such is not always found. Below the point of loss the temperature increased 2° to 3° between logs. This is common, and the crossing of the two logs is often a quick approximation of the zone of loss. Exceptions occur at shallower

(Continued on page 269)



FLUID LEVEL in Ralph W. Vieman 1 well, Danbury, Tex., was located by temperature survey, April 19, 1952. Fig. 5.

THE AUTHORS

W. C. GOINS, JR.

D. DAWSON, JR.

W. C. Goins, Jr., graduated from Texas A. & M. in 1942 with a B.S. degree in Ch. E. After 3½ years service with Chemical Corp. of the U. S. Army he was employed by Gulf Oil Corp. in 1945. Since that date he has roughnecked in South Louisiana, worked as a mud engineer in West Texas, and since 1947 been at the Houston production division chemical laboratory of Gulf in Houston. His present duties include research and evaluation work on muds and oil-well cements and he is instructor for Gulf's mud-specialist school.

D. D. Dawson, Jr., graduated from Rice Institute with a B.S. degree in Ch.E. in 1941. He joined Sinclair Refining Co. as an engineering trainee and was assigned to the Houston refinery. In early 1942 he was called to active duty with the U. S. Naval Reserve and served 5 years until 1947. He then joined Gulf Oil Corp. as petroleum engineer in the production department. He has worked in South Louisiana, Kuwait, and on Texas Gulf Coast. He has specialized primarily in drilling fluids.

CHARGE OVERBOARD . . .

SPLASH . . .

Offshore Exploration on the Gulf Coast

It is accelerating. Its only limits are financial

by S. M. Peña*

VESSELS measuring 104 ft. in length are used in the offshore "fleet." Here is a recording boat (left) and a supply or surveying boat.

ACTIVITY in the shallow waters of the Gulf Coast is accelerating now that Washington has pushed the offshore ownership issue off high center and established the ownership of the so-called "tidelands." Conservatives had been waiting for a concrete move from Washington, but the more aggressive companies used the vacillating time lag to get on a more equal bidding basis with those firms that already had, by virtue of having started years ago, a fairly good offshore coverage.

Offshore seismic explorations areas have no real limit, except financial, because political boundaries are nonexistent. A semireconnaissance right-angle grid of control lines 2 or 3 miles apart serves to divulge the location and the approximate size of existent structures which are conducive to the accumulation of hydrocarbons. A tighter or closer system of lines later outlines the limits and magnitude of each structure for bidding purposes.

It might be said here that the bidding figure is the most critical and important factor of the entire operation, for there have been cases where as little as $2,000 has been the difference between a successful and an unsuccessful $150,000 bid. On the other hand, there was the case where $250,000 was the sole bid for a parcel of land. These examples are special cases, but the problem is always there. Deciding what a parcel of land is probably worth is a highly specialized and all-important function, which rests squarely on the shoulders of management.

Who issues permits for offshore shooting is at present undefined, therefore, it is advisable to request permission from the U. S. Corps of Engineers, the Texas Railroad Commission, the Louisiana Department of Wild Life and Fisheries, and the Department of Conservation of Louisiana, or any other coastal state involved.

Water Operations

Working from U. S. Navigation charts Marine Exploration Co. uses a "fleet" of three boats which operate in coordination with each other and

* Supervisor, Marine Exploration Co., Houston. W. G. Noonan, laboratory superintendent, aided in compiling information for the article.

POSITIONING of boats is accomplished by electronic surveying from land bases. Here a "surveyor" is reading his position in the coordinate system.

BALLOONS are used to mark charge and lines for the shooting crew to follow when regular electronic control is off because of "sky wave" blackouts.

land-based stations by means of constant radio and telephone contact. Two of the boats are Air Sea Rescue vessels measuring 104 ft. in length, converted to diesels. These boats are spacious enough to accommodate a crew of 15 to 18 men, plus their gear. In addition to being seaworthy, they can navigate in waters as shallow as 15 ft., regardless of wave action. The third boat, which measures only 75 ft. in length, serves as a shooting boat, because of its agility and maneuverability. The recording boat, the shooting boat, and the supply boat are all interchangable, for continuous operations.

Surveying . . . The boat called the "supply vessel" can, and often does, double for the observing boat, but generally serves as a surveying guide boat, laying out balloon markers for the shooting crew to follow during electronic "sky-wave" blackouts, and after or before, electronic permissible operation daylight time. The electronic surveying from land base keep the boats oriented and on shooting course at all times. The surveying monitor knows the portion of the Coatinental Shelf within his range like the palm of his hand. He knows every permanent installation within his operation scope, because it has been previously plotted on his operating base and can talk any moving object, tuned to the proper frequency, into any desired location or keep it in any special course. He can determine Lambert X and Y coordinates for every charge that explodes and the exact position of the boats and the cable at all times.

Since Marine Exploration operates on a per shot basis, the operating schedule must be set on a fulltime basis from sunup to sundown. A bonus is paid to field men for each shot taken above and beyond set number for the month.

Equipment . . . The recording boat has a motor-driven rear-deck reel to take up 2,400 ft. of drag cable, which houses self-righting gimbaled detectors and the necessary conductor wires. The cable is reeled in during stormy weather and, of course, at night. Caution must be exercised to keep the cable from kinking or from being nicked by the driving propellers.

The 2,400-ft., 16-station drag cable, which rests on the ocean floor during the shot instant, is as big around as a large man's wrist. Recording equipment except for special filters added to receive the natural frequencies of particular localities, is the same as used for the Rocky Mountains, West Texas, Gulf Coast, swamp areas, inland waters, and the tidelands. The dynamite charge is detonated 8 ft. below the water level and no weathering correction is necessary on the seismograms. The maps are phantoms made in time, rather than depth; and all dips are graphically migrated into the true position before the phantom horizons are compiled.

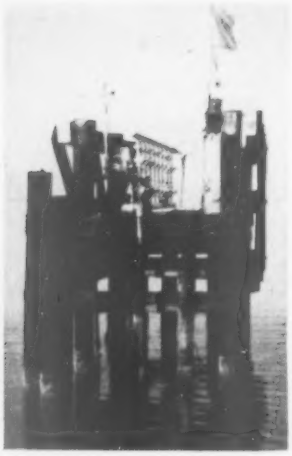
Cost wise, offshore seismic shooting on a per shot turn-key and fulltime operation basis with a bonus clause incentive for the crew may be compared with the other types of seismic shooting as follows. An average month of offshore shooting will cost an oil company a total of $125,000 to $150,000 for 2,500 to 3,000 shots. The coverage would be 500 to 600 miles of line at $250 per mile. Inland waters where the geophones are planted by hand and the dynamite charges are buried in a drilled hole rather than thrown overboard; where small boats and pontooned equipment is used, the cost runs to $160,000 a month for a 22-working-day month. The crew covers a total of 110 miles which costs $550 per mile. Swamp and marsh work cost $30,000 to $35,000 for a 22-work-day month, and this type crew covers 44 miles of line costing $600 to $700 per mile. Gulf Coast land crews will cost $14,000 a month and cover 40 miles during a 22-work-day month, which brings the cost of 1 mile to $350.

From the above figures, it can be seen that, mile for mile, offshore shooting appears to be the least expensive. However, because of almost compulsory saturation of control over blocks anywhere from 4,000 to 6,000 sq. mi. in areal extent and because of the outlay of cash that eats into the exploratory budget very quickly, it is hard to explain that offshore work is relatively inexpensive.

The present-day drillable water depth limits of the Texas Gulf Coast offshore strip 380 miles long and 50 miles wide, lying 10 miles from land can conceivably be surveyed in 2 years by a well-organized offshore crew, averaging 600 miles of continuous subsurface coverage, at a total cost of 3½ million dollars. Similar Louisiana coverage should take 2 years and 3 months and cost slightly over 3¾ million dollars. This seismic coverage would, of course, be adequate for bidding purposes but would not necessarily be sufficiently detailed for drilling. The 10-mile strip of water between the land and the offshore is less than 15 ft. deep and has a very irregular bottom, which does not lend itself to high-speed assembly-line "shooting"; therefore, it falls in the category of inland waters and is at least twice as time consuming and expensive to seismically explore.

Offshore seismic exploration work is expensive but a company must turn to it before entering offshore competition.

SUBMERSIBLE DRILLING BARGE on location in Corpus Christi Bay.



FLOWING WELL PLATFORM with cribbing arrangement.

PUMPING-WELL PLATFORM indicates bolted substructure; note step-down arrangement to well head.

INLAND-WATER DRILLING

. . . on the Texas Gulf Coast

by C. G. Glasscock, Jr.

Here's a comprehensive discussion of marine-drilling problems and techniques, starting with obtaining the permit. Production problems are thoroughly analyzed.

MARINE drilling presents many problems not encountered in drilling operations conducted on land. However, this type of operation is relatively new. Marine drillers will find undoubtedly new and more effective solutions to many of the problems now confronting them. Successful exploration in offshore fields calls for long-range planning, the anticipation of future needs, and considerable technical study.

Permit Procedures

Inasmuch as the coastal waters of Texas are under jurisdiction of seven federal and state agencies, obtaining permits necessary to conduct exploratory and development drilling in these inland waters is a very lengthy process.

The seven federal and state bodies governing offshore drilling include the U. S. Corps of Engineers; the Army and Navy; U. S. Department of the Interior; U. S. Coast Guard; Texas Fish, Game and Oyster Commission; and the Oil and Gas Division of the Texas Railroad Commission.

The usual procedure for obtaining the necessary permits to drill is listed below in outline form:

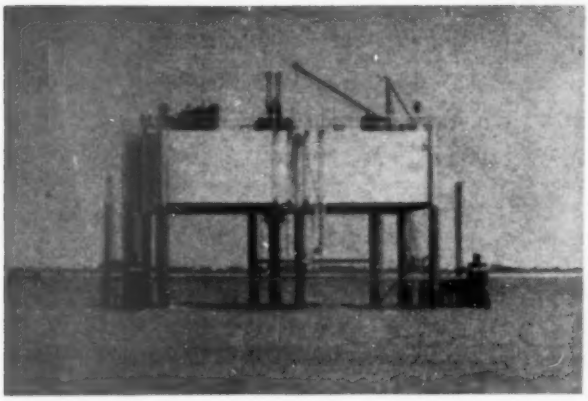
1. Blanket Permits.

(a) Plats showing location of the particular lease block to be explored, drawn and certified to by a registered engineer, must be prepared and sent to the district engineer of the U. S. Corps of Engineers. Usually two linen tracings and six ozalid prints of each plat will be sufficient.

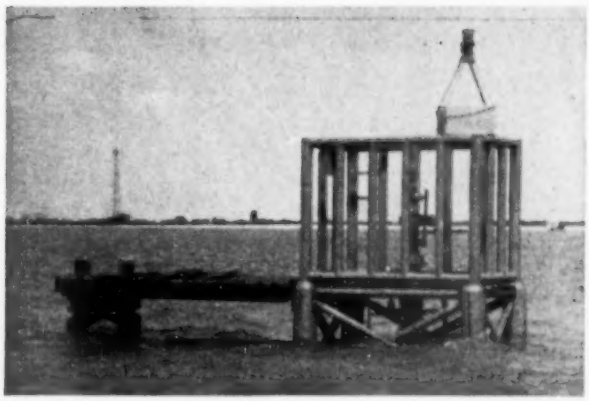
(b) Detail drawings showing typical barge protective structure or proposed piling structure for conventional rig base must be submitted. As in the case

WELL-HEAD PROTECTION is obtained by wooden enclosure on this platform; creosoted piling is used for supports.

TANK-BATTERY BARGE is moved to position and sunk on shell mat. Note obstruction light mounted on tank at right.



PREFABRICATED, SUBMERSIBLE-TYPE tank-battery barge employs a submerged bottom section which can be pumped out and floated to new location.



PREFABRICATED PROTECTION for well heads employed steel construction which is also used for the supports. Note danger light mounted above structure.

of (a), two linen tracings and six ozalid prints should be sufficient.

(c) Plats of the typical channel to location and the turnaround for drilling platform or barge must be made, showing water depths as indicated on U. S. Coast and Geodetic Survey navigation maps or determined by actual soundings done by the prospective operator. Length, width, and profile of all dredging done at the location must be shown.

(d) Plats showing well-head protective structures to be used after completion of the well are necessary.

(e) Plats indicating tank-battery locations and construction details of the batteries are required.

(f) Location of flow lines must be shown.

(g) A formal letter of application must be attached to the above plats, requesting "authorization to erect and maintain structures and appurtenances to be used in drilling wells for the production of oil or gas; to produce, transport or store such oil or gas; to erect and maintain structures of steel or timber, including, but not by way of limitation, derricks, platforms, runways or walks, docks, tanks, loading racks, protective structures and foundations therefor; to construct and maintain moorings or markers; to drive test pilings and conduct coring operations; and to lay and maintain pipelines for the transportation of water, oil or gas."

Approval of the blanket permit usually takes a minimum of 6 weeks. Occasionally it may take longer and no operations may be commenced before its final approval.

In adidtion to the inspection by the various agencies already mentioned, notices must be sent to all parties who might be interested, from the standpoint of navigation, in the work outlined and the structures planned. Plans may be seen by these interested parties at the district engineer's office during a 12-day waiting period designated by the engineer. If no objections are registered during this period, the application may be forwarded to the various agencies for their approval or rejection, as the case may be.

When the blanket permit has been approved, a file number will be assigned and all correspondence relating to the permit should refer to the assigned file number.

2. Bonds.

Before a blanket permit can be issued, the U. S. Corps of Engineers must be furnished with evidence to show that a bond of $10,000 has been posted, covering operations listed under the blanket permit. The bond is required to insure that all structures will be built as set down in the approved plans and will be removed after abandonment of the wells, erasing any possibility of navigational hazards.

3. Specific Permits.

(a) Drawings in the form of two linen tracings and six ozalid copies showing the following features should be submitted; (1) exact well location; (2) dredging plan showing location and dimensions of channels and basins; (3) detail plats of construction plan of protective structure for drilling barge and completed well; (4) plats showing exact location of storage facilities and construction details of these facilities; (5) plats showing exact location of pipe lines, indicating the size of pipe to be used and the depth at which they will be buried; and formal letter application submitted as on the blanket permit application.

Specific well permits may be applied for during the waiting time on the blanket permit. These permits, of course, cannot be granted until after approval of the blanket permit. However, a considerable amount of time can be saved by submitting the two simultaneously since a minimum of 3 weeks is required for the issuance of specific permits.

With the approval of the blanket permit and the specific well permits, the operator may then prepare the relatively simple **Form 1 (Application to Drill)** and submit it to the Texas Railroad Commission.

The Corps of Engineers must be notified of the date of commencement as well as the date of completion of all work which it has authorized. Then notifications will enable the corps to have a representative on hand to inspect the premises, if it wishes to do so.

Drilling Procedures

Inland-water locations may be drilled by the following methods:

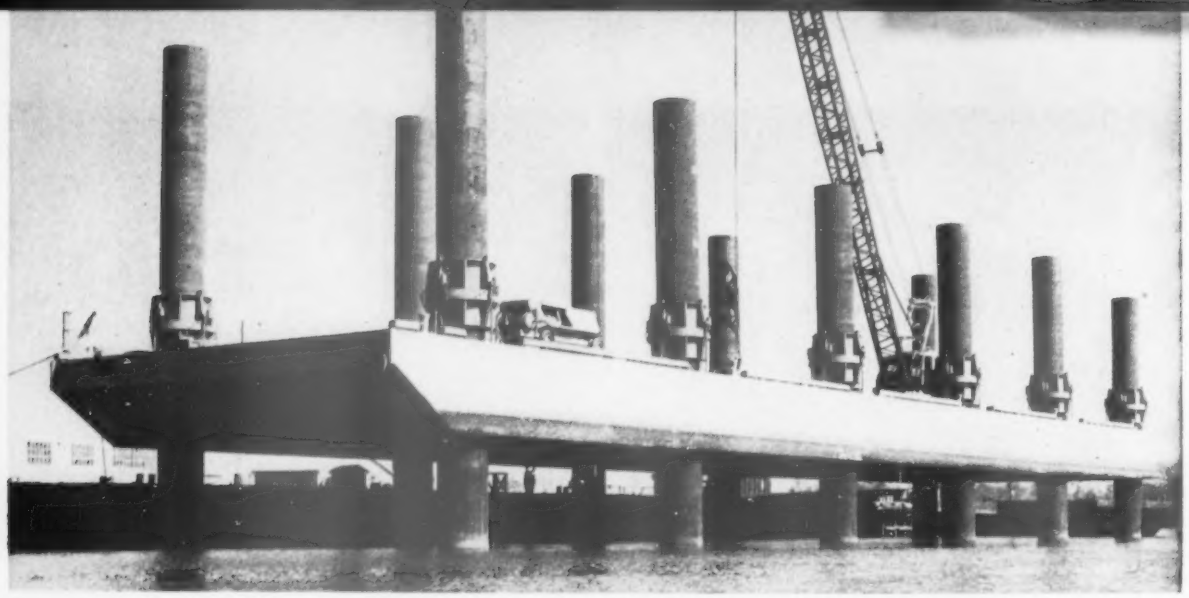
1. T-head or man-made island . . . This method can be employed when the location is in proximity to an accessible land base, and in sufficiently shallow water so that bulkheads can be built and material pumped in to furnish a

(Continued on page 321)

THE AUTHOR

GLASSCOCK, JR.

C. G. Glasscock, Jr., is a partner in C. G. Glasscock Drilling Co., of Corpus Christi, Tex., and head of its land and production department. A native of San Antonio, Glasscock attended Baylor University at Waco. After graduation he entered the drilling-contracting industry. He is also president and owner of Twin "G" Drilling Co., a contracting firm operating in Colorado. He is a member of the board of directors of the Baylor University Ex-Students Association, and a trustee of University of Corpus Christi. An aviation enthusiast, he flies his own plane, a Bonanza, to many of the Glasscock company's 10 drilling rigs.



THIS BIG BARGE, which jacks itself up to any desired level, may prove the answer to greater mobility for offshore drilling. Air jacks circling the big caissons at deck level climb themselves up the caissons, taking the hull up with them.

OPERATION BOOTSTRAP

Built-In Jacks Position New Barge

Gulf Coast tests prove value for offshore-drilling operations

A NEW-TYPE barge which can float anywhere, set its "feet" down, and literally "jack" itself up to any height, may be the next major development in offshore drilling.

Designed by Col. Leon B. DeLong, head of DeLong Engineering & Construction Co., of New York City, this type barge is being fabricated at the Orange, Tex., plant of Consolidated Western Steel, a division of United States Steel Corp.

The novel feature which makes the barge different from all others is that a simple mechanical principle is incorporated which resembles that of a boy "shinnying" himself up a tree trunk. Huge jacks, built within the structure, raise the barge up 6 in. at a time, to any level desired.

Not only does this development offer many possibilities for use in offshore-drilling operations, but it may revolutionize military and commercial port operations.

Consolidated is now fabricating six of the barges for the U. S. Army. They will be 300 ft. long, 90 ft. wide, and 13 ft. deep, and will weigh about 5½ million pounds each.

Features . . . Interior of the barge is laced with honeycombs of rigid steel ribs. Spaced along the hull's port and starboard sides is a series of "wells," each consisting of a 6-ft.-diameter hole in the deck and a corresponding one in the bottom. Wells serve an important purpose when the barge reaches job site. Until that time, the lower holes are bulkheads.

All gear is carried with the barge and tools to put it in operation when job site is reached. This "gear" consists primarily of a battery of steel tubes, or caissons, 6 ft. in diameter, 100 or more feet long, and built from ¾-in. plate. The "tools" are air jacks, one for each caisson. The caissons support the barge, literally turning it into a dock, and the air jacks take it up the caissons to the desired height.

At location, with the hull resting on the water's surface, the steel stilts are dropped through the wells and through the jacks set up around the tops of the wells to the ocean floor. Then they are pile-driven to solid footing.

Jacking up . . . The jacks then go into action. These are the main feature of the barge, in that they put the "climbing" principle into operation. The caisson is literally a tree trunk. The entire design of the barge is built around these air jacks.

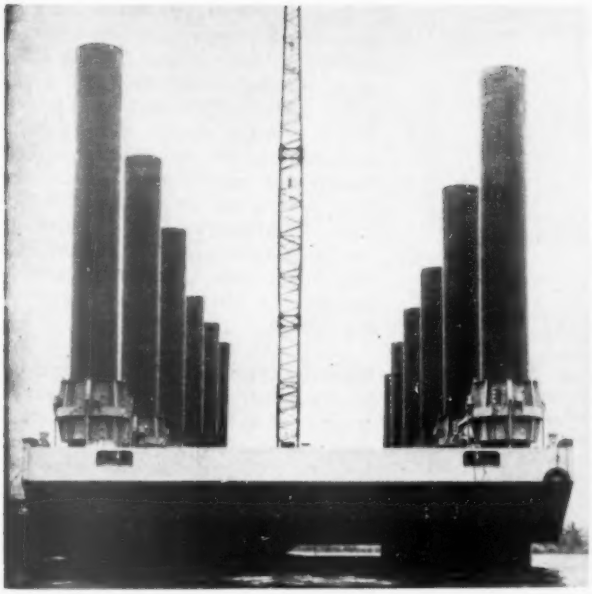
In the simplest terms, a jack is a steel cylinder about 7 ft. high and a little over 6 ft. in diameter, with contoured ribs that give the illusion of a barrel. It is sliced horizontally across the center into two sections that function in much the same manner as the hands and legs of a tree climber.

A boy climbing a tree grips the trunk with his knees to prevent slipping as he reaches his hands upward for a new grip. Then he loosens his legs, pulls himself up by his hand, and again grasps the trunk with his knees. Hands go upward for a new hold and he repeats the operation.

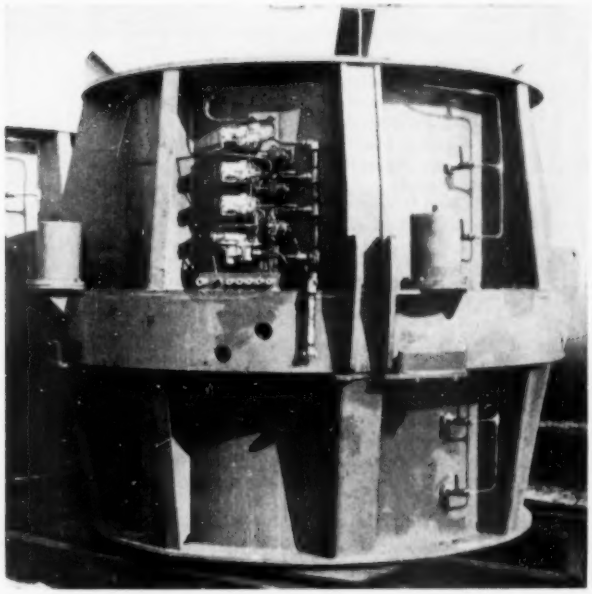
The upper half of the air jack, like a boy's arms, lifts the load of the barge. The lower section, like a boy's legs, holds it in place while the top half reaches upward for a new grip on the caisson.

How jack works . . . The top of the jack is bolted to steel tie rods, anchored to the deck. Both upper and lower halves are equipped with air-operated rubber grippers, tire-like tubes circling the inside wall between jack and caisson. Another set of similar tubes circle the caisson between the upper and lower jack sections.

When the dock is in position and the caissons are on bedrock, the jack is raised 6 in. above deck level. Air is pumped into the rubber tubes of the lower half and it takes a firm grasp on the caisson. Next, the rubber tubes between the jack sections are inflated,



HEAD-ON VIEW of one of the barges during testing operations at Orange, Tex., where they are fabricated by Consolidated Western Steel.



CONSTRUCTION DETAILS of the air jack, which is the key item in design of the dock barges. Principle is similar to a boy climbing a tree trunk.

which forces the top half up 6 in.

The tubes in the top are then inflated, clamping the upper half of the caisson and holding the barge at that height, while the lower grippers are released and the center tubes deflated.

Retraction pulls the lower section upward, where it is again clamped and the operation completed. Thus with all jacks working simultaneously, the entire hull of the barge climbs 6 in. at a time, each jack pulling itself and its burden up the caisson.

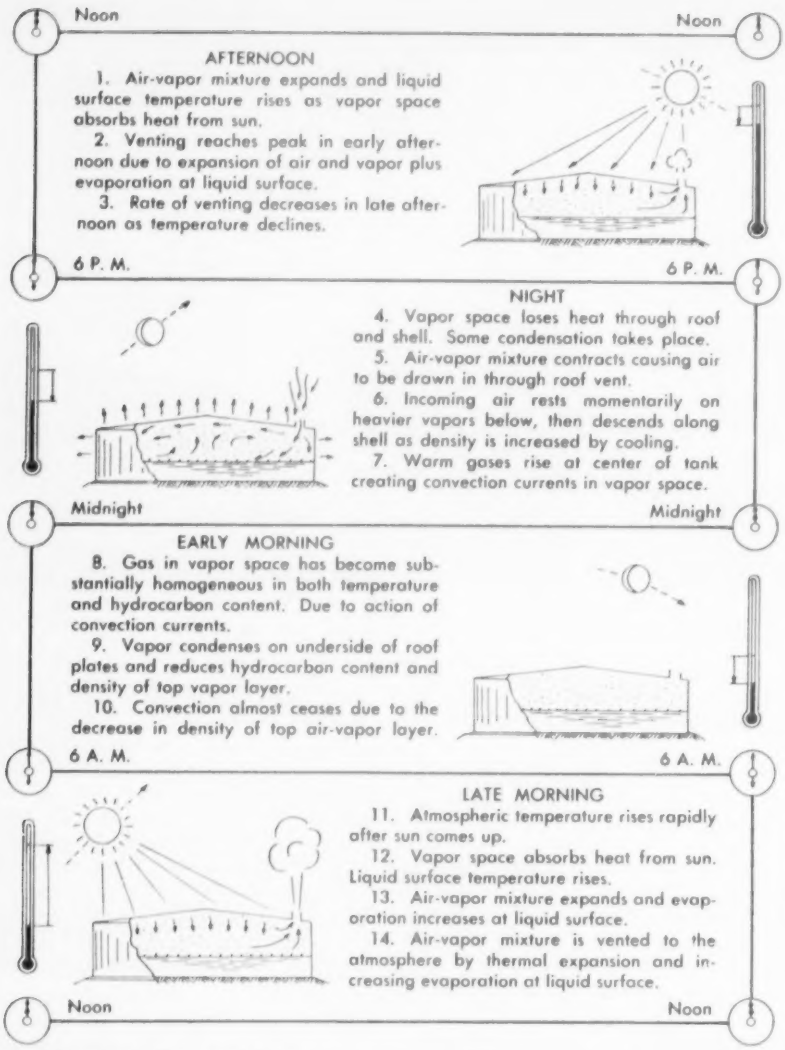
When the jacks have done their job, the wells are capped with steel plates bolted to the deck across the top of the caisson, holding the hull sturdily on the caissons. After erection, the jacks may be left permanently in place or stored.

When casting off for a new location, which takes only a few hours, cap plates are removed and the jacking operation reversed, allowing the dock to descend the caissons to water level. Caissons are pulled out and loaded on deck. The barge is then ready to sail.

Best answer yet . . . In offshore-drilling operations, extensive testing in the Gulf of Mexico has convinced DeLong engineers they have come up with "the best answer yet devised to the problem of mobility." The back-breaking job of jumping a drilling barge and its load from one location to the next is accomplished by the new dock barge smoothly as it moves from one dock site to another.

AN AIR-POWERED "climbing" jack in operation. It is built in two sections, the upper fastened to the deck by tie rods. Each half is lined with rubber tire-like tubes with similar tubes circling the caisson between the sections.

DECK VIEW of the new-type dock barge, showing air jacks in place around their respective caissons, ready for action. DeLong Engineering & Construction Co. is the designer of the barge.


Noon
Noon
AFTERNOON
1. Air-vapor mixture expands and liquid surface temperature rises as vapor space absorbs heat from sun.
2. Venting reaches peak in early afternoon due to expansion of air and vapor plus evaporation at liquid surface.
3. Rate of venting decreases in late afternoon as temperature declines.
6 P. M.
6 P. M.
NIGHT
4. Vapor space loses heat through roof and shell. Some condensation takes place.
5. Air-vapor mixture contracts causing air to be drawn in through roof vent.
6. Incoming air rests momentarily on heavier vapors below, then descends along shell as density is increased by cooling.
7. Warm gases rise at center of tank creating convection currents in vapor space.
Midnight
Midnight
EARLY MORNING
8. Gas in vapor space has become substantially homogeneous in both temperature and hydrocarbon content. Due to action of convection currents.
9. Vapor condenses on underside of roof plates and reduces hydrocarbon content and density of top vapor layer.
10. Convection almost ceases due to the decrease in density of top air-vapor layer.
6 A. M.
6 A. M.
LATE MORNING
11. Atmospheric temperature rises rapidly after sun comes up.
12. Vapor space absorbs heat from sun. Liquid surface temperature rises.
13. Air-vapor mixture expands and evaporation increases at liquid surface.
14. Air-vapor mixture is vented to the atmosphere by thermal expansion and increasing evaporation at liquid surface.
Noon
Noon

DAILY BREATHING CYCLE, showing mechanism of evaporation losses, for atmospheric-pressure, fixed-roof storage tanks. Fig. 1.

EVAPORATION LOSSES . . .

. . . and an economic analysis of equipment for recovering vaporized hydrocarbons, by two Gulf Coast engineers.

by N. H. Prater* and R. M. Huff, Jr.*

EVERY day, approximately three-quarters of a million gallons of gasoline are vaporized in storage or in handling at United States refineries. The quantity of gasoline lost to the atmosphere in 1 day is sufficient to provide a thousand motorists with a yearly supply of fuel. Only a few plants have the necessary facilities for the recovery of these vapors. This may be explained by the insufficient realization of the magnitude of these losses and of the rapid payoff of the equipment required to do it.

*Technical department, refining division, Magnolia Petroleum Co., Beaumont, Tex.

Highest evaporation losses occur in atmospheric-pressure fixed-roof storage tanks. A normal 24-hour cycle in these tanks showing conditions under which losses occur is illustrated in Fig. 1.

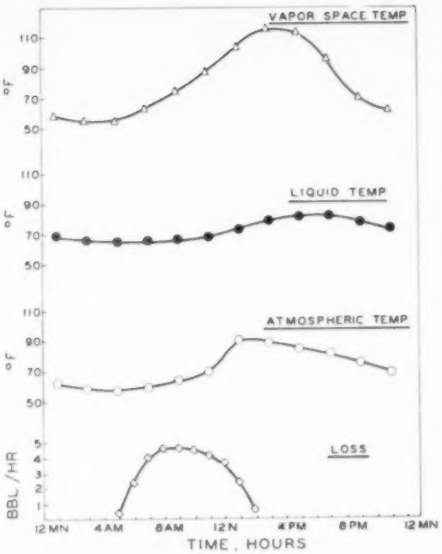
The principal factors causing evaporation losses are well known but their interrelation and the effect of the less obvious variables are obscure. The factors which are difficult to evaluate are: solar radiation, wind, atmospheric conditions, and tank conditions including the absorption efficiency of the surface.

Breathing cycle . . . The breathing cycle is illustrated by the data presented graphically in Fig. 2. The tank conditions remain fairly stable from 2:00 a.m. to 5:00 a.m. At this time the vapor-space temperature in the tank closely approaches that of the atmosphere. The liquid temperature remains slightly higher but is uniform throughout the liquid mass. This results in a loss of heat through the tank walls to the atmosphere. Consequently, the layer of liquid nearest the wall will be cooler and tend to move toward the tank bottom, resulting in mild convection currents inside the liquid body.

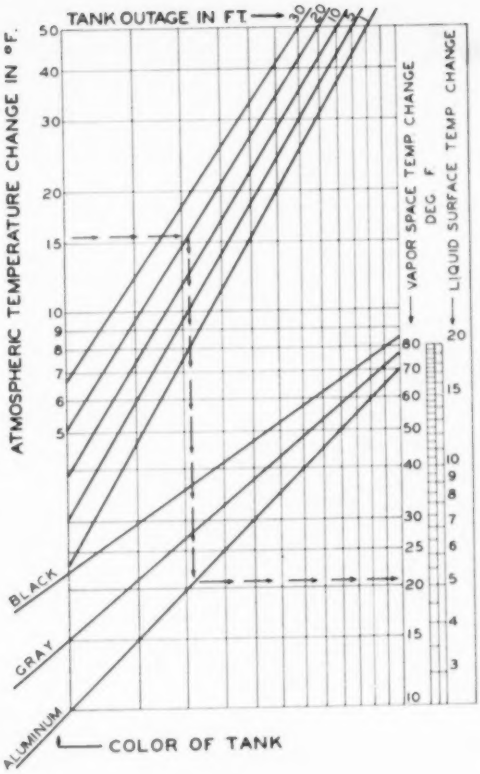
Temperature gradients in the vapor space cause mild convection currents in the vapor. As the cooler vapors near the tank roof and sides move downward, due to their greater density, warm vapors from near the liquid surface rise to fill this potential void space. The warmer vapors near the liquid surface are richer in hydrocarbons. The continuous rotation of cool and warm vapors ultimately results in a uniform air-vapor mixture in the tank vapor space.

From 5:00 a.m. until sunrise, the atmospheric temperature increases slowly and the tanks begin to vent a uniform air-vapor mixing. After sunrise, the temperature rises rapidly and heat is delivered to the tank roof and sides by direct solar radiation. This heat raises the temperature of the liquid nearest the shell to a temperature above that of the main liquid body. The warm liquid rises along the tank wall and spreads over the top surface. The vapor pressure of this warm liquid is above that of the remainder of the liquid body and causes a rapid evaporation of the hydrocarbons into the vapor space. Additional heat is supplied to the vapors by convection and conduction through the tank roof and sides above the liquid level.

As the vapor-space temperature increases, the air-vapor mixture expands and vapors are expelled from the tank. Venting continues throughout most of the day. It ceases soon after the atmospheric temperature begins to fall



TYPICAL 24-HOUR CYCLE for gasoline storage tank, showing interrelations of losses, vapor-space temperature, liquid surface temperature, and atmospheric temperature. Fig. 2.



ESTIMATED TEMPERATURE CHANGES in vertical cylindrical storage tanks. Fig. 3.

off, and the heat starts flowing in the reverse direction. As the atmospheric temperature further decreases after nightfall, some condensation of gasoline vapors occurs within the tank producing a slight vacuum which draws air into the tank through the vents.

The incoming air collects first above the heavier vapors, but due to the variations in temperature within the tank convection currents are set up. The air descends along the tank shell and is replaced by a warmer mixture of air and vapor rising in the center of the vapor space. Mixing continues until the vapor space becomes almost homogeneous with respect to temperature and saturation. Normally, a uniform mixture of air and gasoline vapors is obtained between 2:00 and 5:00 a.m. when the new cycle begins. Wind, rain, clouds, etc., have a definite effect upon the magnitude of gasoline losses. Fig. 2 illustrates the interrelations of losses, vapor-space temperature, liquid surface temperature, and atmospheric temperature for a normal 24-hour cycle.

Calculated losses . . . The actual losses for a year-round period cannot be directly determined without a vast amount of testing. They can be approximated, however, from data easily available. The following expression for calculating breathing losses from fixed-roof tanks may be derived by the use of a few basic relations:[5]

$$B = \frac{PNEV}{100\,AC} \quad (1)$$

Where:

B = product loss by tank breathing, gal.
P = vapor pressure of stored material at liquid body temperature, psia.
N = period for which loss is computed, days.
E = expansion of air-vapor mixture, per cent.
V = volume of tank vapor space, cu. ft.
A = atmospheric pressure, psia.
C = volume occupied by evaporation of 1 gal. of stored material, cu. ft.

The per cent expansion of the air-vapor mixture may be calculated by the following equation:

$$E = 0.2\,T + \frac{100\,(H - Y)\,(P_2 - P_1)}{H\,(A - P_2)} \quad (2)$$

Where:

T = average daily vapor space temperature change, °F.
H = tank height in feet.
Y = average outage in feet; i.e., the distance from the top of the tank shell to the liquid surface.
P_2 = vapor pressure of stored product at average daily maximum liquid surface temperature.
P_1 = vapor pressure of stored product at average daily minimum liquid surface temperature
A = atmospheric pressure in psia.

Fig. 3 may be used in connection with Equation 2 to determine the liquid surface and vapor space temperature change.

Example . . . Determine the evaporation loss from an aluminum painted tank, 40 ft. high and 120-ft. diameter, containing a 10-psi. R.v.p. gasoline at 20-ft. outage. The gasoline was stored for 1 month in September. The following conditions were obtained from the Weather Bureau:

Average daily maximum atmospheric temperature = 81° F.
Average daily minimum atmospheric temperature = 65° F.
Average daily mean atmospheric temperature = 73° F.
Average daily atmospheric temperature change = 16° F.

From Fig. 3, the average daily vapor space temperature change is found to be 31° F. and the average daily liquid surface temperature change 5.3° F. The minimum liquid surface temperature reached during the night is equal to the mean average atmospheric temperature, and the average liquid body temperature is usually approximated as 4 per cent greater than the mean atmospheric temperature.[5] On this basis the following minimum and maximum liquid surface temperatures are obtained:

Average daily maximum liquid surface temperature = 73 + 5.3 = 78.3° F.
Vapor pressure at 78.3° F. = 7.1 psia.
Vapor pressure at 73° F. = 6.5 psia.
Change in vapor pressure = 0.6 psia.

$$E = 0.2 \times 31 + \frac{100\,(40 - 20)\,(7.1 - 6.5)}{40\,(14.7 - 7.1)}$$

$= 6.2 + 3.95 = 9.15$ per cent

Average liquid body temperature = $1.04 \times 73° \text{ F.} = 76° \text{ F.}$

Vapor pressure at 76° F. = 6.9 psia.

The remaining data required in computing the breathing loss from Equation 1 are as follows: From tank dimensions with 20-ft. outage, the volume of the vapor space is 250,000 cu. ft. Approximate atmospheric pressure is 14.7 psia. The evaporation of 1 gal. of average gasoline produces 30 cu. ft. vapor. Substituting the foregoing values in Equation 1.

$$B = \frac{6.9 \times 31 \times 0.0915 \times 250{,}000}{100 \times 14.7 \times 30}$$

$$= 11{,}168 \text{ gal.}$$

Filling losses . . . The filling losses may be calculated by the following equation:

$$F = \frac{PD}{7.5\,AC} \qquad (3)$$

Where:

F = filling loss in gallons.

P = vapor pressure of product at tank liquid temperature in psia.

D = throughput or number of gallons pumped into tank.

A = atmospheric pressure in psi.

C = number of cu. ft. of vapor formed by the evaporation of 1 gal. of product pumped.

The results obtained by this method were found to be consistently low by 10 to 15 per cent. It is suitable for estimating breathing and filling losses from normal storage in fixed-roof tanks. The method fails in predicting losses from tanks with abnormally high temperatures as may occur in unit rundown tanks or from unstable stocks with very high vapor pressure.

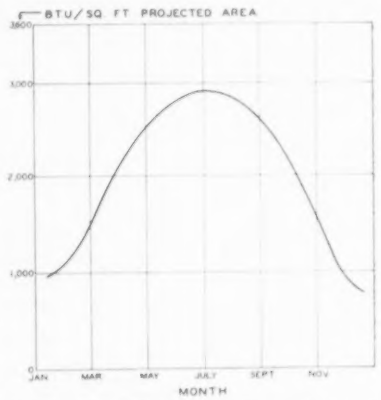
Measured losses . . . A simple method has been devised by which the tank losses can be accurately measured. The test work was done on tanks having conservation-type vents. Capacity calibration curves for these vents were obtained from the manufacturer and found to be correct. These curves express flow as a function of tank vapor-space pressure. Pressures inside the tank vapor space were determined with an inclined manometer using a light-gravity oil as the liquid medium. The vapor-space temperature and liquid temperatures were obtained at various points by a potentiometer and thermocouple. A special sample hatch cover was fitted with connections for manometer, thermocouple, and sample point.

Vapor samples were obtained with an aspirator displacing vapors into evacuated glass sample bombs. The liquid samples were tested for Reid vapor pressure. Vapor samples were analyzed on the mass spectrometer for specific gravity and composition. Atmospheric temperatures were taken with an ordinary thermometer and verified with Weather Bureau temperatures. Pressure readings in the vapor space combined with conservation vent calibration charts were used to determine the flow of air-vapor mixture from the tank. From these data the vapor losses were estimated and compared with those calculated by various methods.

Studies were conducted on crude oil, motor gasoline, and aviation gasoline. These studies revealed that the method presented in this article agrees more consistently with the observed losses than other published methods.[1,3,4,5] None of the methods are valid, however, for calculating losses while blending butane into gasoline. This is due to the abnormal losses of volatile butane as it is introduced into the tank. Comparison of the results obtained by calculations and actual measurements is shown in Table 1.

None of the methods studied for calculating evaporation losses predicts the losses exactly. This is due to the many uncertain factors affecting evaporation losses which cannot be accounted for in the formula. If attempts are made to account for these factors, only the average effect is included. For example, average values for temperature changes, vapor pressure changes, and per cent saturation of the air-vapor mixtures are used.

Radiation effects . . . Other factors affecting evaporation losses but not accounted for in empirical solutions are: radiation from the sun, wind, and tank condition. The amount of radiation from the surroundings cannot definitely be established since it depends upon locality. Solar radiation differs widely as the local conditions change due to dust, humicity, absorption efficiency of the tank surface, and status of overcast. The intensity of solar radiation is dependent upon such factors as time of year, time of day and latitude. It is usually greatest during June.[2,6,7] The approximate amount of heat received per square foot of projected tank surface in the Gulf Coast area is illustrated in Fig. 4. They were calculated assuming clear daylight weather.



AVERAGE SOLAR HEAT received per square foot of projected tank surface for a 12-hour period, 5 a.m. to 5 p.m. Fig. 4.

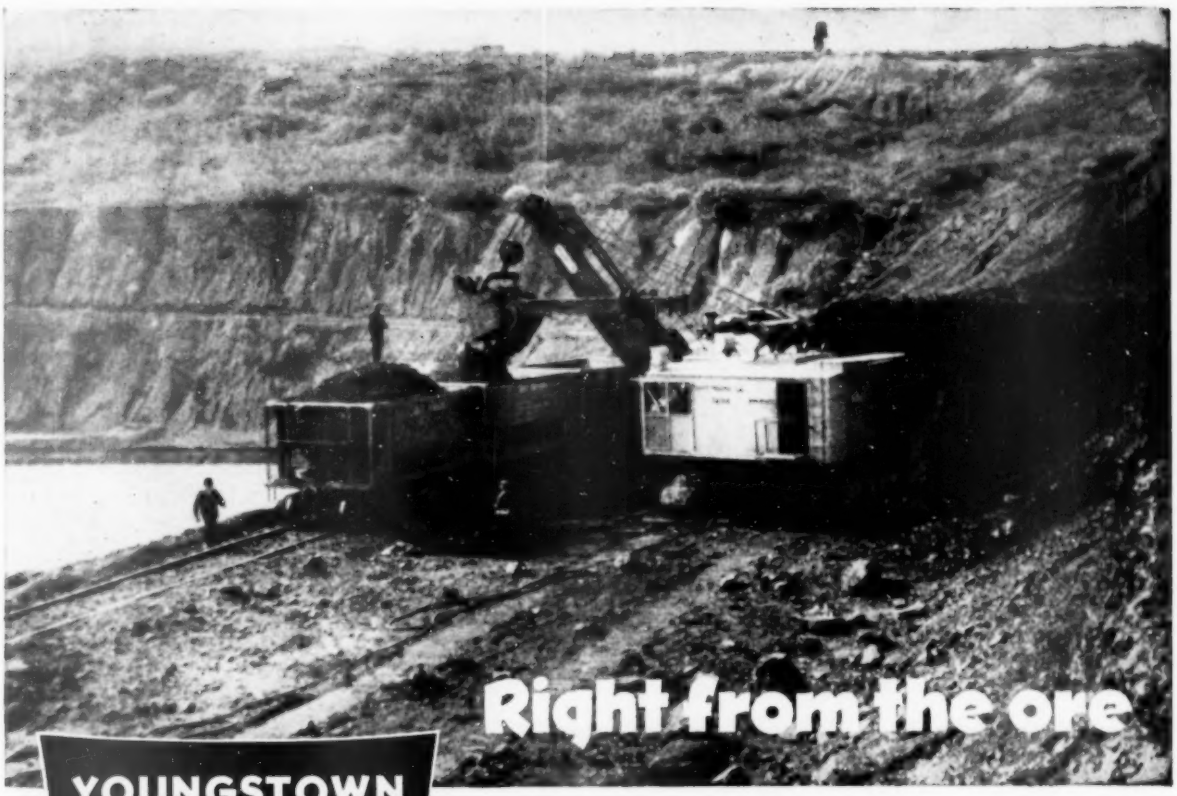
Not all the solar radiation falling upon the projected area of the tank is absorbed. The amount absorbed depends upon the reflection characteristics of the tank surface. The approximate reflection and absorption powers of various colors are illustrated in Table 2.

The amount of heat actually absorbed by the tank can be estimated by applying the color correction factor from the above table to values obtained from Fig. 4.

TABLE 1—COMPARISON OF CALCULATED AND ACTUAL LOSSES FROM FIXED-ROOF STORAGE TANKS

Product stored and method—	Loss factor*— Breathing	Filling	Pressuring
7-psi. R.v.p. aviation gasoline:			
GATX	0.90	....	....
A	2.06	....	....
B	0.27	....	....
C	0.89	....	....
10.4-psi. R.v.p. gasoline:			
GATX	0.92	0.88	0.46
A	1.12	0.92	0.60
B	0.60	1.56	0.30
C	0.95	0.46	0.47
6-psi. R.v.p. crude:			
GATX	0.92	....	....
A	1.20	....	....
B	0.65	....	....
C	0.90	....	....

*Loss factor is the ratio of calculated to actual losses.



YOUNGSTOWN
Electric Weld
LINE PIPE

Uniformly satisfactory in service because—

Long lengths save time and trouble

Weldability is outstanding

It bends readily

Line up characteristics are excellent

QUALITY SERVICE

RIGID QUALITY CONTROL

●One important reason why Youngstown Electric Weld Pipe is so uniformly satisfactory is that its production is under the sole supervision of a single integrated organization—from mining the ore to shipping the finished product.

Youngstown Electric Weld Pipe for the oil and gas industry is being made in sizes up to 22" OD and in grades as high as X52. For further information, phone or write our nearest District Sales Office.

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices: Youngstown, Ohio - Export Office: 500 Fifth Avenue, New York 36, N. Y.

PIPE AND TUBULAR PRODUCTS - CONDUIT - BARS - RODS - COLD FINISHED CARBON AND ALLOY BARS - SHEETS - PLATES - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RAILROAD TRACK SPIKES

A New, Powerful DRAWWORKS

in the medium-heavy drilling class

Meet Bethlehem's M-810—a smooth, power-packed drawworks built for work in the medium-heavy drilling range. It's a rig that hasn't been hurried along; we spent years designing, testing, and checking the pilot model before the M-810 was released for production.

This is a tough, sturdy rig equipped with mechanical drive, fluid coupling, or torque converter—whichever you choose. It's a rig with tremendous clutch capacity (low-speed drum clutch, 102,000 ft-lb). Compare this with the figure you'll find in competitive rigs of the same class!

The M-810 has other fine features, too—features that help make the going easier, less costly. For instance:

- **Extra-large, extra-powerful brakes cooled by enclosed circulating-water system**
- **2- or 3-engine drive with single or double pump drive**
- **Disconnecting Airflex clutch-controlled pump drives**
- **Big, strong shafts throughout; short bearing centers**
- **Engine compound and drawworks transmission clutches of disengaging spline type; master and high- and low-speed drum-drive clutches of extra-high-capacity air friction type**

The M-810 is a highly flexible rig that permits a wide latitude in the choice of engines and engine combinations. Moreover, it's designed for easy moving from place to place; the engine compound is a sectionalized type, and the width of the drawworks is well within required road limits.

You are invited to see and inspect this new, high-speed drawworks. Take all the time you want; there are many details you'll need to know, and we'll be glad to explain them fully.

BETHLEHEM STEEL

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second St., Tulsa, Okla.
West Coast Headquarters: Los Angeles, Calif.
Export Distributor: Bethlehem Steel Export Corporation 25 Broadway, New York, N. Y.
Canadian Representative: Rocky Mountain Supply Co., Ltd. Calgary, Alberta

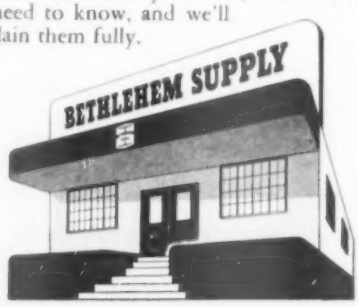


TABLE 2—EFFECT OF TANK COLOR ON SOLAR HEAT REFLECTION*

	Per cent	
	Reflected	Absorbed
White	82	18
Gray	52	48
Aluminum	40	60
Black	1	99

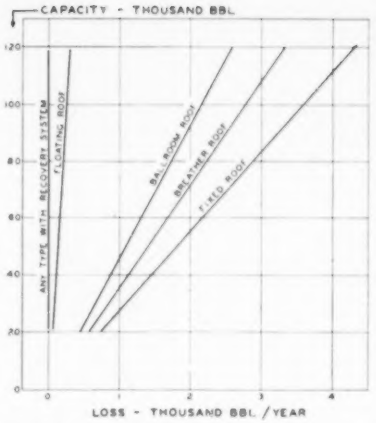
*Values are for unweathered paint.

Heat absorbed by a tank due to solar radiation is often much greater than heat delivered by convection and conduction from the air. As the temperature of the tank increases, the temperature difference which is the driving force decreases. In most instances, the average tank vapor space temperature will rise above that of the surrounding atmosphere. At this condition, some of the heat absorbed by solar radiation is delivered by convection and conduction from the tanks to the surrounding atmosphere.

Economic factors . . . The engineer designing complete tankage facilities should determine by economic balance which type is best suited to his particular situation. This balance is based upon total cost of tank per barrel of storage over the amortized period, maintenance, and losses connected with each type of storage. A comparison of the approximate breathing and filling losses for various types of tanks in crude-oil storage service is presented in Fig. 5. As a basis for estimating losses the tanks are assumed to be filled and emptied 25 times per year.

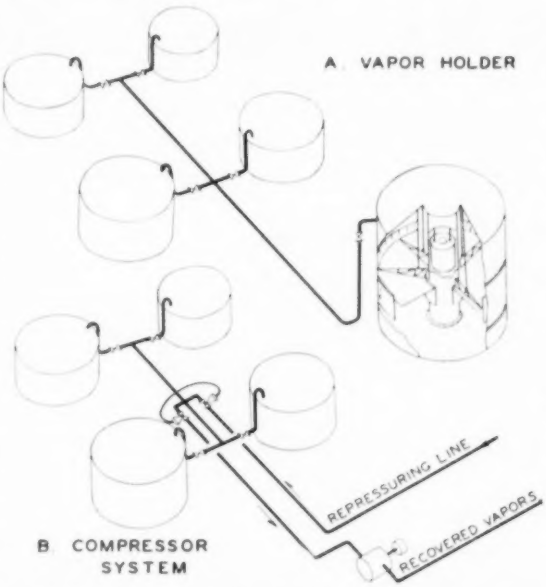
Many factors have to be considered in determining the most economical type storage. For example, the losses from fixed-roof tanks are considerably larger than from floating-roof tanks. However, the initial cost and maintenance for floating-roof tanks are much larger than for fixed-roof tanks. It follows, therefore, that an economic balance should be made in terms of cost (investment, maintenance, losses, and amortization) per barrel of stored material.

Conversion of fixed-roof tanks to conservation types is usually difficult to justify due to high cost of installation and excessive idle time. This is especially true if tanks are riveted. Losses from large multiple fixed-roof tank systems can be prevented economically only by installation of suitable vapor-recovery equipment. Losses from small systems may be prevented more economically by converting the existing equipment to conservation-type tanks.



BREATHING LOSSES from standard type storage tanks. Fig. 5.

Fixed-roof tanks can seldom hold a pressure or vacuum above 1.75 in. of water and usually 1.33 in. of water is set as the upper limit. Conservation vents are normally set to open at 0.865 in. of water pressure or vacuum. For this reason it is imperative that vapor-handling lines be of large diameter since the maximum allowable pressure drop in the lines cannot exceed the vent setting. If the allowable pressure drop is exceeded, some vapor will be vented to the atmosphere instead of going to the recovery system.



VAPOR-RECOVERY SYSTEMS show expansion of basic system to recover breathing, blending, and filling losses by the addition of either a compressor system or a low-pressure gas holder. Fig. 6.

System justification . . . Justification for vapor-recovery installations is affected both by the type of recovery system employed and by the disposition of the recovered material. The basic equipment consists of lines connecting each tank to a common manifold. This system is particularly efficient where the stored products are moved out at a constant rate. The filling losses are thus eliminated since the quantity of influent and effluent materials are equal at all times. Material transfers within the system do not affect the over-all vapor recovery since the displaced vapors from the tank being filled are transferred to tank or tanks from which liquid is pumped.

This basic system may be expanded to recover breathing and blending losses as well as filling losses by the addition of either a compressor system or a low-pressure gas holder. These systems are illustrated in Fig. 6. The installation of a compressor system requires less capital investment than the gas holder but maintenance and operating costs make it less attractive for a long range return on the investment.

The compressor system requires a repressuring agent when the pressure in the tank vapor space drops below 0 psig. Sweet natural gas is normally used for this purpose. The necessity of keeping the pressure-control equipment in proper working condition results in high maintenance costs. With equipment operating satisfactorily, the compressor must handle only the evaporated material from the tanks.

With poor operation such as improper pressure setting, or with mechanical failure of the pressure control equipment, the repressuring system might remain open to the tank system continuously. As a result the tank system would always be under pressure and the compressor would be required to handle the excess repressuring agent in addition to the normal volume of evaporated material. With either good or poor operation, the compressed vapors subsequently must be rehandled in an absorber system or utilized as fuel.

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7. Moon, P., J. Franklin Inst., 230, 583 (1940).

1 KEY PUNCH . . . Oil data are punched into cards, which are then arranged. Part of the 22 microfilm reader machines are shown.

2 CODE DESK . . . Here all problems are cleared and resolved between the clerical work and key punch machine work; also scheduling of work.

3 CLIMACTIC POINT . . . The latest type of punch-card machine shown here, it adds, subtracts, and types the Texas oil and gas data information directly onto specially prepared, continuous plates for reproduction. This is done at the rate of 150 lines per minute (each line composed of 75 characters).

4 MASTER PLATES . . . These are placed in the multilith machines shown here, where printing takes place for the monthly reports.

Texas Now Has More Than 33,000 Leases

. . . and the task of riding herd on the compilation and maintenance of statistics on these leases is monumental. But the Gulf Coast's Lockwood company does just that

by C. D. Lockwood

MORE than 33,000 leases are producing crude oil in the State of Texas. This figure, perhaps more than anything else, illustrates the growth of the petroleum industry in the Lone Star State since the end of World War II. On V-J Day, 8 years ago, there were just a few more than 20,000 producing leases in the state. The increase, therefore, has amounted to about 65 per cent.

These figures indicate why the handling of petroleum statistics has followed the pattern of many other tasks into the field of high speed automechanization.

Before World War II, several of the larger oil and pipe-line companies each kept their own individual records of lease and reservoir production. In the middle thirties, the expansion of proven oil territory in South Texas and the Gulf Coast deposited serious burdens on the various statistical staffs of the

CUMULATIVE CRUDE-OIL PRODUCTION FOR TEXAS' GULF COAST AREAS

Railroad districts	1	2	3	4	Total
	Number of leases per railroad district				
Over 10 million barrels	0	8	31	5	44
1 to 10 million barrels	63	127	430	211	831
Total over 1 million barrels	63	135	461	216	875

TEXAS GULF COAST—NUMBER OF PRODUCING CRUDE-OIL LEASES
(As of January each year)

R. R. Dist.	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953
1	723	476	744	755	744		663	662	674	685	730	779	812	848	931	959
2	316	336	359	436	537		699	373	806	868	964	1,048	1,104	1,264	1,389	1,489
3	1,651	1,991	2,164	2,265	2,335		2,400	2,454	2,506	2,578	2,632	2,758	2,947	3,198	3,479	3,724
4	1,164	1,339	1,499	1,666	1,741		1,785	1,854	1,973	1,990	2,094	2,274	2,382	2,582	2,739	2,883
Total	3,854	4,412	4,766	5,122	5,357		5,547	5,707	5,959	6,121	6,420	6,859	7,245	7,892	8,508	9,055

TEXAS GULF COAST—NUMBER OF PRODUCING CRUDE-OIL RESERVOIRS
(As of January each year)

R. R. Dist.	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953
1	52	56	56	60	58			55	55	58	61	77	84	91	107	121
2	39	44	46	55	60			85	102	106	117	133	152	188	202	241
3	95	104	114	124	141			161	176	182	197	219	241	281	325	411
4	85	97	138	138	150			174	219	234	277	326	363	432	521	581
Total	271	301	354	377	409			476	552	580	652	755	840	992	1,155	1,354

oil companies. These burdens increased steadily as the progress of petroleum engineering called for greater efficiency and accuracy.

For the past 8 years a great many of the primary statistical problems connected with Texas oil and gas production data have been handled by C. D. Lockwood Co., of Houston. Modern techniques, including the use of microfilm and the latest punched-card accounting system, have enabled this company to compile and publish data each month, in the form desired by the industry, on 33,000 producing oil leases, 3,100 producing oil reservoirs, 4,600 operating companies, 9,200 gas wells, 1,500 gas reservoirs, 300 gasoline plants, and 350 crude-oil gatherers and pipe-line companies.

Oil men customarily think in terms of daily averages. To convert the foregoing totals alone into the desired averages requires more than 50,000 separate computations each month because the source material is reported only in the form of monthly totals. In addition to compiling and publishing these production figures each month, the Lockwood company compiles annual reports on each oil lease and each gas well in Texas, as well as annual totals by reservoirs.

At the time C. D. Lockwood started this service in 1944, no cumulative totals of production by lease were available in many areas of Texas. More than 3 years were spent in research on the project before the cumulative totals by leases could be added to the other services. Today, the annual reports include cumulative totals on all leases except a relatively small number which have been producing for more than 20 or 25 years. Some of the records on these very old properties simply are not now in existence.

The Lockwood organization also serves the transportation and economics branches of the industry through its reports entitled "Receipts, Deliveries, and Stocks of Crude Oil and Condensate," and "Balance Sheets for Executives." The former report lists all receipts and deliveries of crude oil from the time the oil leaves a lease unti it enters a refinery or is shipped out of the state. It lists stocks of crude by company and district of origin and station. Approximately 15,000 items are listed each month.

The Balance Sheets for Executives represents a summary of the detailed report, showing for each area of Texas, and for Texas as a whole, where the oil comes from and where it goes.

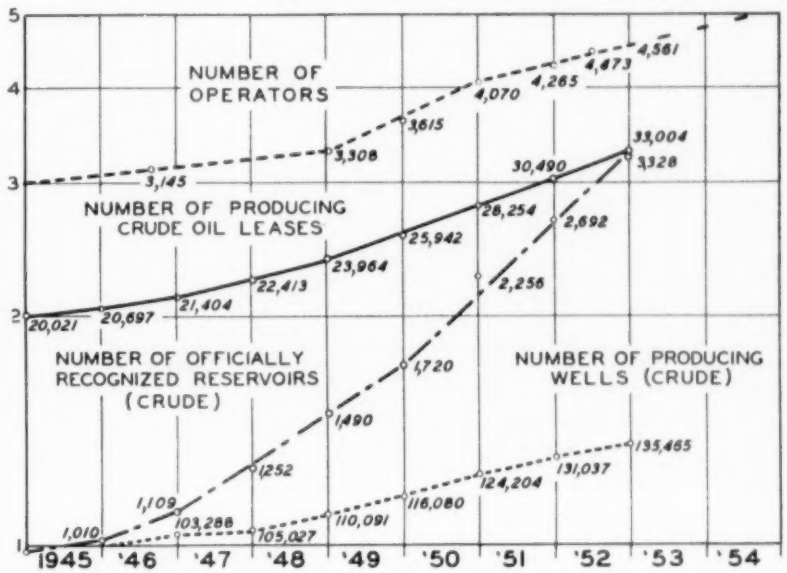
The Gas Plant Report lists each plant with all available data on intake and disposition of gas, as well as production, delivery, and stocks of products.

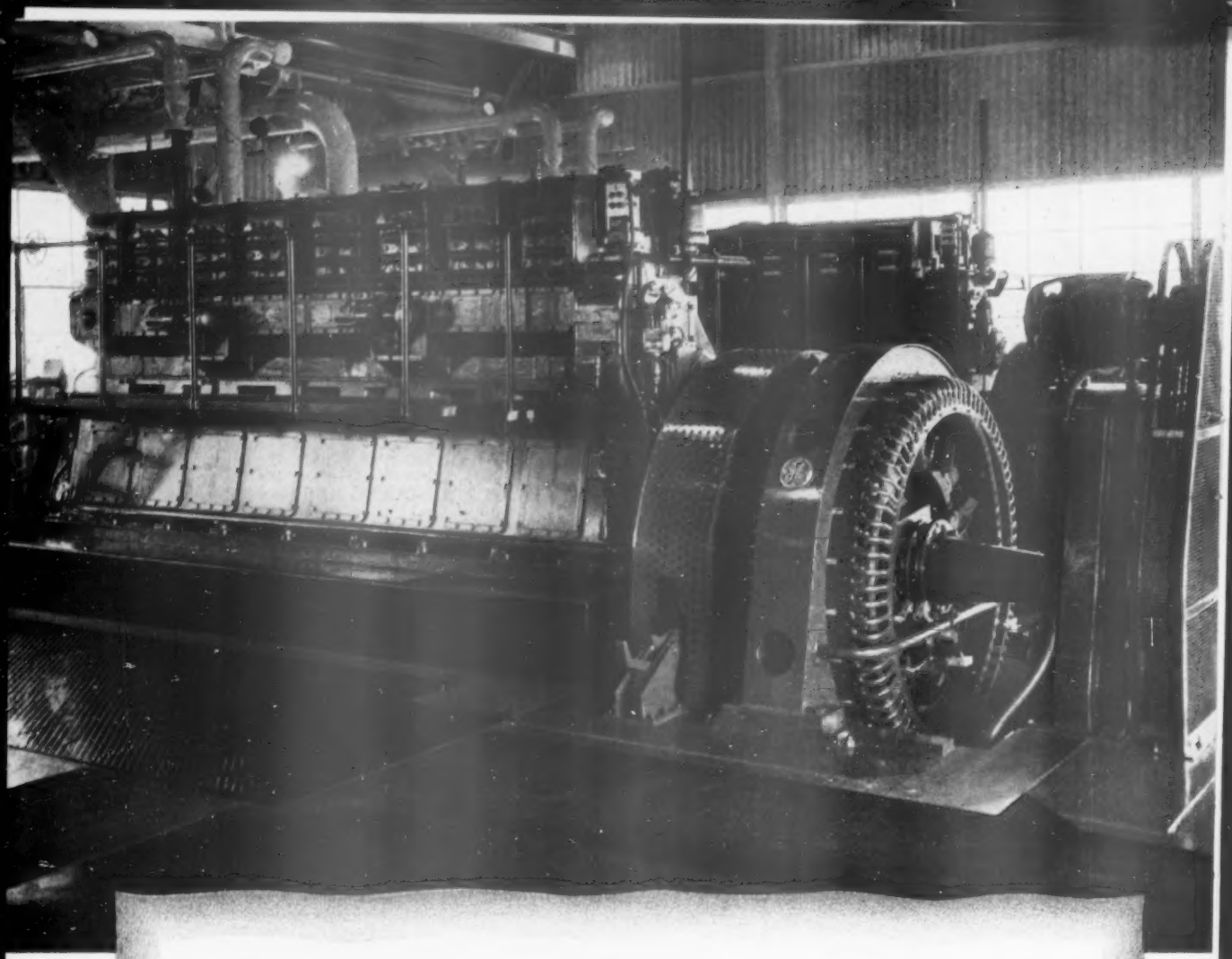
Now, since casing-head gas has become such a factor in the economics of the industry, another report is being added. This will show casing-head-gas production by leases, involving approximately 18,000 leases each month, and the full 33,000 leases twice a year. Annual totals by lease will be computed.

Every 3 months, punched cards showing the total production and number of wells in each reservoir throughout the state are sorted into order by companies. From these cards, a report is prepared showing each of the 4,600 operating companies in alphabetical order, with the company's production and number of wells in each field. This report now covers nearly 350 legal-size pages. At the close of World War II, there were just a few more than 3,000 companies, individuals, and partnerships represented in this book.

All of the eight different reports cover 3,500 separate pages of data each month. In the Lockwood office, however, there are only four typewriters because all except about 300 pages of the 3,500 are typed directly onto Multilith master plates by an I.B.M. accounting-printing machine, from punched cards. This machine, of the latest type, adds company and field

STATE OF TEXAS PRODUCING OPERATIONS



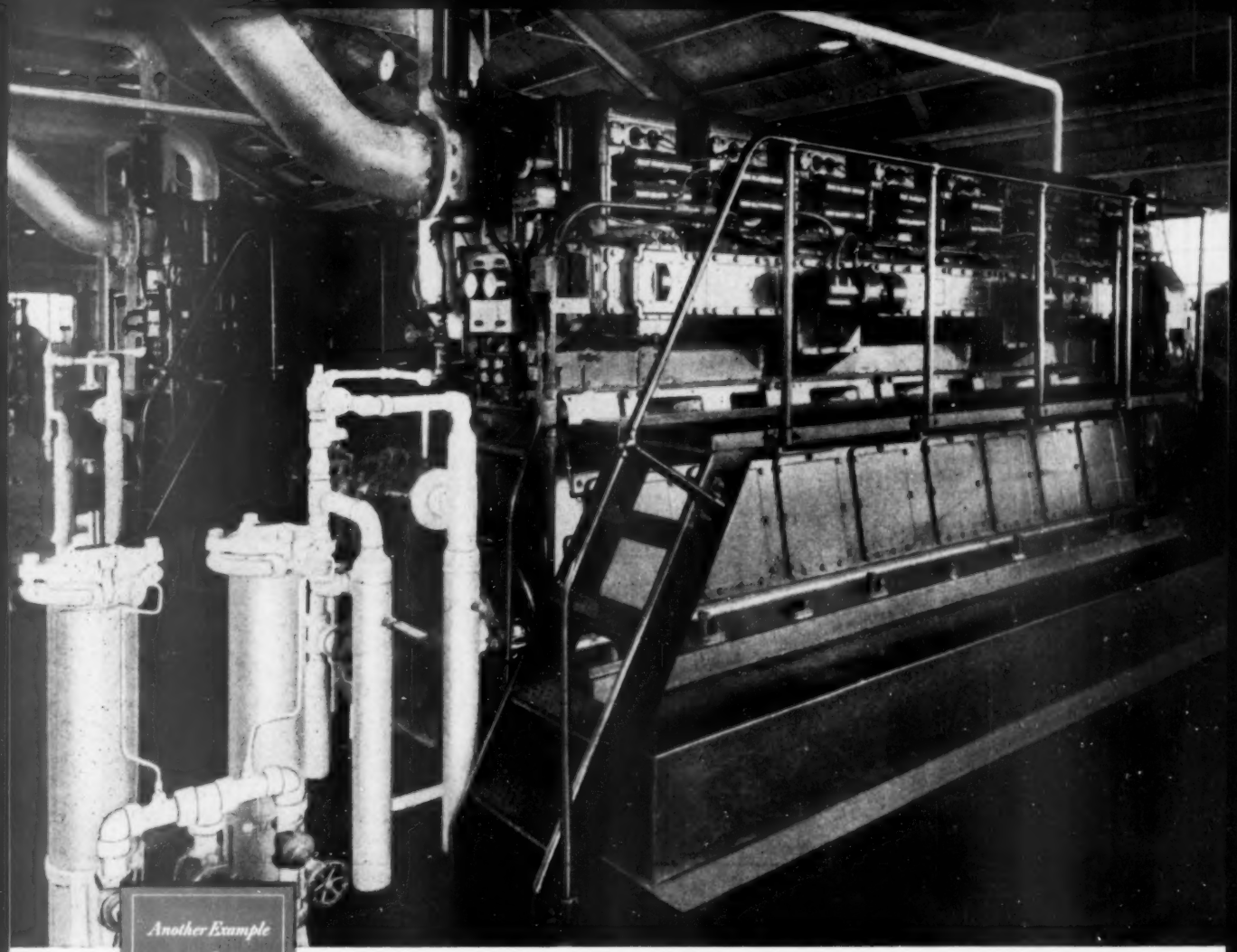


24-YEAR PROGRESS WITH COOPER-BESSEMERS *on the Texas to Illinois Lines*

GAS · DIESEL · GAS-DIESEL ENGINES

New York Washington, D. C. Bradford, Pa.

San Francisco, Cal. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash.



Another Example of Efficient Power at Lower Cost

Cooper-Bessemer 600 hp, JS-8 gas engine generator units recently installed in Texas-Illinois stations at Marshall, Texas, and Malvern, Arkansas. Duplicate installations already installed on the line are located at New Caney, Texas, Biggers, Arkansas, and Hoffman, Illinois.

SHOWN here are some of the latest Cooper-Bessemer gas engine generating units installed in Texas-Illinois Natural Gas Pipeline Company's new pipeline. Modern JS's like these have now gone into five Texas-Illinois stations; will likewise power 4 more new stations as the year goes on.

Texas to Illinois experience with Cooper-Bessemer power dates back to 1929 when Cooper-Bessemers were first installed on the old Texoma and Natural Gas Pipeline Company of America lines. Like the modern JS's, these old engines were noted for dependability, low maintenance and high efficiency . . . and they're still running!

But progress plays tricks with standards. For example, the old Texas to Illinois engines offered 25% thermal efficiency — 10,000 B.T.U. consumption per bhp/hr. Today, you can install Cooper-Bessemers guaranteed not to exceed 6500 B.T.U. per bhp/hr.

Think what this unmatched 40% thermal efficiency means in dollars saved. It's equivalent to buying your gas at older, lower rates! Better check up on what you stand to gain and save with modern Cooper-Bessemers on the job.

by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Tulsa Shreveport St. Louis Los Angeles Chicago

TEN LARGEST LEASES (OIL RECOVERY) IN TEXAS GULF COAST

	Cumulative oil production to March 1, 1953
DISTRICT 1	
Darst Creek, Humble Oil & Ref. Co., L. C. Denman "A"	7,889,054
Luling, Magnolia Petroleum Co., A. J. Baker	6,520,006
Luling, Magnolia Petroleum Co., J. E. Allen	5,859,643
Darst Creek, Sun Oil Co., Knoblock "C"	5,519,505
Luling, Magnolia Petroleum Co., Alf Mercer	5,305,825
Darst Creek, Gulf Oil Corp., Dix & McKean A	4,865,464
Luling, Magnolia Petroleum Co., L. Marines	4,732,674
Luling, Magnolia Petroleum Co., W. H. Tabor	4,195,493
Darst Creek, The Texas Co., Knoblock C B	4,188,851
Darst Creek, Magnolia Petroleum Co., Dix Thos	3,778,790
DISTRICT 2	
West Ranch, Magnolia Petroleum Co., West Ranch A	47,804,335
Tom O'Connor, Quintana Oil Co., Thomas O'Connor A	33,530,209
Tom O'Connor, Union Production Co., Lambert	20,863,055
Tom O'Connor, Quintana Oil Co., Fannie V. Heard	17,958,439
Tom O'Connor, Quintana Oil Co., Thomas O'Connor C	16,345,035
Greta, Hewitt, C. Est of Dougherty, Lambert	15,471,279
Tom O'Connor, Quintana Oil Co., Maude Williams A	13,017,847
Tom O'Connor, Hewitt, C. Est. of Dougherty, M. F. Lambert	10,877,929
McFaddin, Sunray Oil Corp., McFaddin	9,911,388
Tom O'Connor, Copano Oil Co., O'Connor A	8,185,086
Tom O'Connor, Copano Oil Co., O'Connor E	7,949,844
DISTRICT 3	
West Columbia, The Texas Co., W. C. Hogg	43,127,272
Webster, Humble Oil & Ref. Co., Scott Beamer	35,736,142
Spindletop, Stanolind Oil & Gas Co., McFaddin	33,365,312
Sour Lake, The Texas Co., Texaco Co. fee	27,217,489
Conroe, Humble Oil & Ref. Co., So. Texas Devel. Co. A	25,342,930
Thompson 5,000 ft., Gulf Oil Corp., F. I. Booth et al. A	22,598,931
Webster, Humble Oil & Ref. Co., Humble West B Acl	21,681,483
Conroe, Humble Oil & Ref. Co., H. H. Moore	21,097,834
Humble, The Texas Co., Stevenson fee	20,767,243
Oyster Bayou, Sun Oil Co., Felix Jackson	20,450,769
DISTRICT 4	
Plymouth, Plymouth Oil Co., Welder C	31,009,756
Willamar West, Pan Am Production Co., Willamar West Unit	14,251,992
Tijerina Canaks Blucher, Humble Oil & Ref. Co., King Ranch	12,548,974
Stratton, Humble Oil & Ref. Co., King Ranch Stratton	12,111,117
Conoco Driscoll, Continental Oil Co., Robert Driscoll A	10,141,731
Rincon, Continental Oil Co., Slick B	9,999,261
Stratton, So. Minerals Corp., Stratton Comm. Bert	9,742,346
Richard King, So. Minerals Corp., King	9,089,748
Seeligson Zone 19C, Sun Oil Co., Canales Zones 19C	7,639,948
Seeligson Zone 19C, Magnolia Petroleum Co., Seeligson 19C	7,000,290

totals and types the totals in their proper places while it is typing the individual lease or well data, company name, and field name.

Preparation of the cards for the final listing is accomplished by approved accounting methods. Each of the 33,000 leases in Texas is balanced individually, with the previous month's closing storage carried over into the new card, and the current month's production, pipe-line runs, and closing storage key punched into the same card. Those leases which do not balance are ejected automatically by the machines for correction or further inspection.

Special problems are created in the handling of year-to-date totals and cumulatives when leases are subdivided or when certain wells on a lease are found, due to additional geological information, to belong in a different reservoir. Consolidations and reinstatements of leases require special handling, as do also the workovers when wells are plugged back or deepened from one reservoir to another.

Changes of ownership require careful inspection because the identifying punched holes must be altered, necessitating a new set of cards. The same applies to changes of field names, changes of pipe-line connection, and changes of lease name. Leases on the borderline between crude and condensate also cause trouble as they switch from one classification to another and back again.

Altogether, for various reasons, approximately 1,500 leases change in some way each month.

Added to the 33,000 original cards which must be handled each month are another 1,000 or so corrected or amended reports sent in by operators to adjust one or another of the various figures shown on the original report. Most of these corrections are minor and might be classed as technical, but they must be incorporated in the printed reports.

Since the production reports are sent in by more than 4,600 different operators it is inevitable that a few of them will be filled out in such a way that it is difficult to handle them. Fortunately, there aren't many of these, and most of them are easily disposed of, but they add to the time required for complete processing of the material.

Use of Data in Petroleum Engineering

The widespread use of petroleum engineering by the larger independent operators during the past few years has broadened the appreciation of the value of accurate production data. Technicians who evaluate producing properties, individually and by reservoir, are largely responsible for the growing acceptance of the fact that there are variations in quality of statistics quite as pronounced as in other commodities.

The first thing most engineers want to look at when they are studying an oil-producing property is the actual performance of the lease for as long a period of time as practicable. They want to take a look, also, at the performance of surrounding properties which may have been producing for a longer period of time than the one under review. Also, lease lines seldom bear any relation to structure.

If the time element is a consideration, this is sometimes difficult. To meet the needs of technicians pressed for time, the Lockwood organization posts 33,000 ledger cards each month, each card representing an individual lease. A separate set of ledger cards carries the month-to-month records of each gas well in Texas (outside of the Panhandle).

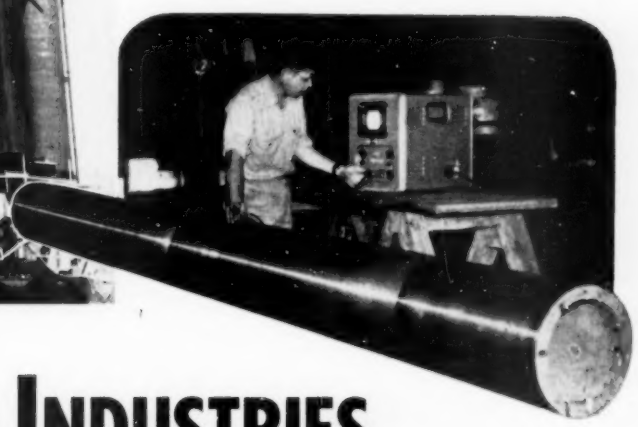
The posted records, like the monthly and yearly reports, are handled by machine. Therefore, the figures on the ledger cards are identical with the original figures in the monthly books. In fact, the ledger cards are posted from the same original cards which were used in the first place. The only variations from this procedure are the 1,000 to 1,500 leases each month which change ownership, field name, or lease name. And, of course, the new leases which must be added, and the abandonments which must be removed.

For the technical man, it is quite important to know that basic unit figures are included in the various totals he must employ in his work. The use of machine-accounting procedures, and the presentation of complete detailed data solve this problem because all totals, no matter how the detailed leases are arranged, must agree exactly. In the Lockwood reports, reservoir totals are provided, and the complete list of leases, with the number of producing wells on each lease, can be inspected by the technician to see if the classification agrees with other technical data he is using in his work.

ACIPCO STEEL

Centrifugally Spun

TUBES...



. . . in the

OIL AND GAS INDUSTRIES

ACIPCO has long produced high quality centrifugal cast iron pipe for the oil and gas industries; and now, another ACIPCO product is meeting nationwide approval—ACIPCO STEEL centrifugally spun tubes.

ACIPCO tubes are manufactured to meet national standard specifications or can be made to special non-standard analyses. A wide range of sizes in lengths up to 16 feet are available and can be made to order promptly. Typical applications include: Hydraulic cylinders, casing heads, cracking still tubes, retorts, slush pump liners, drill collars and furnace tubes. In addition, they are receiving wide recognition as a component in weldment applications. ACIPCO tubes can easily be further shaped by conventional forging methods; and their strength is not impaired by directional lines of weakness.

Investigate the many advantages offered by this versatile product.

SIZE RANGES: 2¼"—50" O.D.; ⅜"—4" wall.
TYPES: Carbon, alloy and stainless steel, cast iron and Ni-Resist.
SPECIFICATIONS: A.S.T.M., A.M.S., A.B.S., A.C.I., and A.I.S.I.

AMERICAN CAST IRON PIPE COMPANY

Birmingham 2, Alabama

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Please send me a free copy of your "ACIPCO STEEL" catalog.

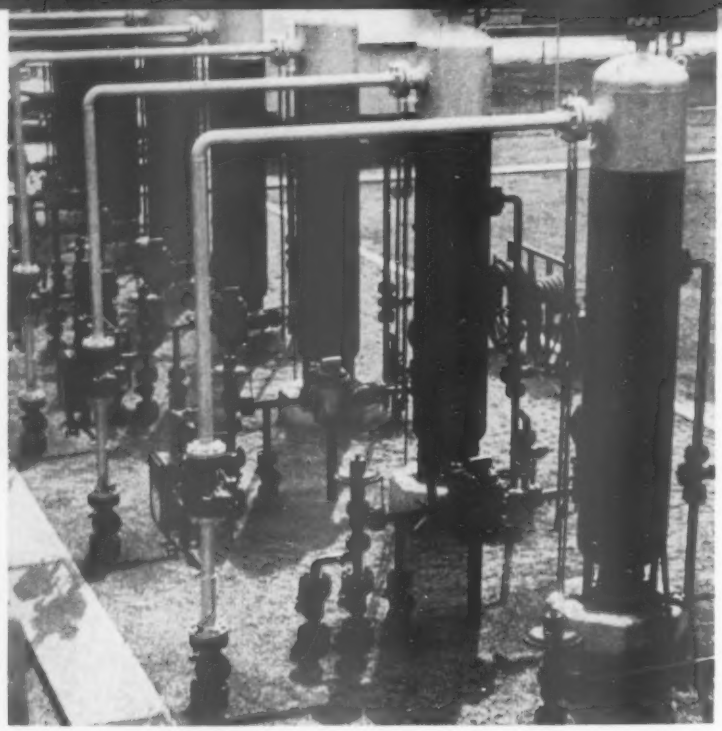
Name.....

Company.....

Street.....

City..... Zone..... State.....

CORROSION-INHIBITOR STICKS are dropped down the tubing through the lubricator on this christmas tree. Bottom-hole corrosion is mitigated in this manner.



HIGH-PRESSURE METERING hookups, shown installed on these separators, are used to measure individual well gas and condensate production. Background tanks are used to calibrate condensate meters.

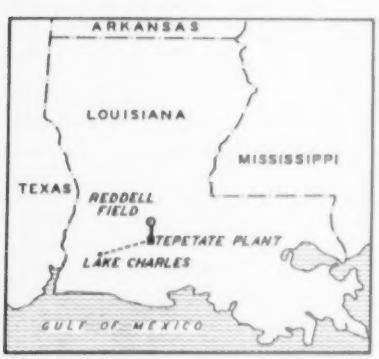
GULF COAST FIELD REPORT

Gas-Condensate Operations at Reddell

by D. E. Gregg

REDDELL field is located in Evangeline Parish, Louisiana, about 70 miles from the Gulf of Mexico. As a high-pressure gas-condensate operations, highlights in this field are:

- **Gas hydrate control and techniques of flow-line heater operation.**
- **Severe tubing-corrosion problem —inhibition program in progress.**
- **Centralized field-wide gathering system.**
- **Field separation with high-pressure metering of individual well condensate and gas production.**
- **Transportation of recombined gas and condensate in 20-mile pipe line to stabilization facilities and gas transmission line.**



PLACE-FIX MAP shows location of Reddell field, Tepetate plant, and pipe lines connecting field and plant. Also shown is pipe line connecting the plant with Lake Charles.

Reddell field was discovered in November 1943, when Continental-Humble 3 Pardee Lumber Co. was completed at 9,960 ft. in the Tate sand. Pay zone was also found in the Haas sand about 150 ft. higher which, like the Tate, is a member of the Sparta formation of Eocene age and productive from other fields in this area. In development through 1949, 15 wells were completed in the Tate and 3 in the Haas; 1 Tate sand well has since been plugged back to the Haas.

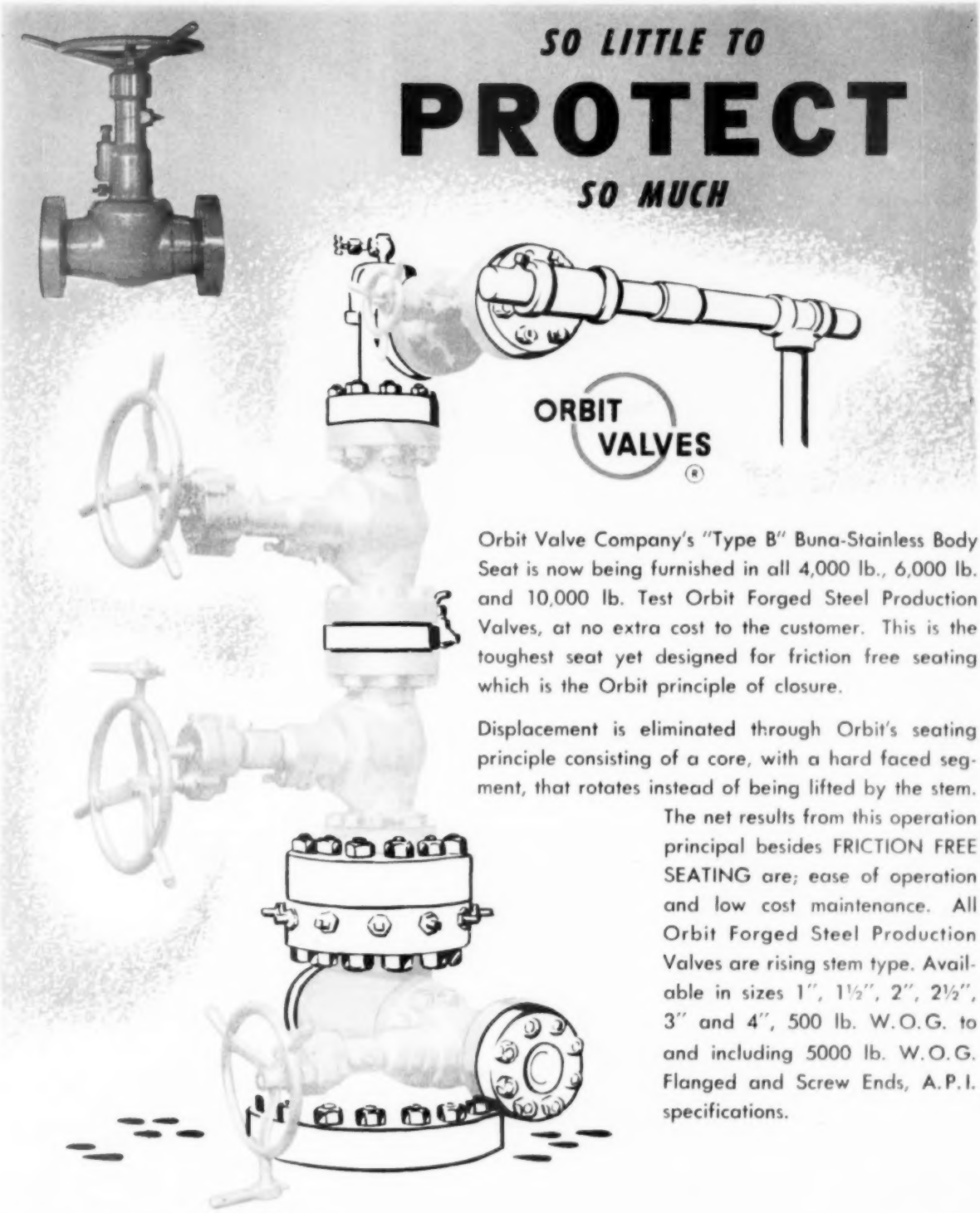
Two producing wells were drilled by Southern Production Co., one by Tide Water Associated Oil Co., and the remainder by Continental Oil Co., operator of leases held jointly with Humble Oil & Refining Co. Three dry holes were drilled prior to and four after the field's discovery and one well, although logging Tate pay, was temporarily abandoned because it was located in a developed Tate sand unit.

Recent drilling by Pan American Gas Co., and Pan American Producing Co. has resulted in additional production on the south flank of the field. This drilling program is still in progress.

Geology

The Reddell structure is a complexly faulted, slightly elongated dome believed to overlie a deep-seated salt dome. The structural features are considered text-book examples of this type of salt-dome structure: a central graben along the main axis of the dome, additional parallel faults forming smaller grabens, and a very complex system of transverse faulting. Where the faults are of sufficient displacement they divide the producing zones into separate reservoirs.

The prospect was mapped before drilling from gravity and seismic data. Subsurface information from early dry holes led to the discovery location.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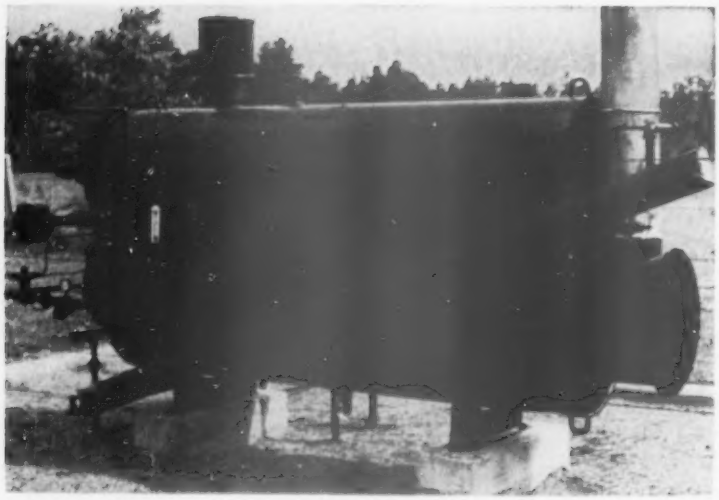


INDIRECT HEATERS near wells and at intermediate points in long flow lines are used to keep gas temperature above the hydrate point. Inclined pipe is fuel-gas scrubber.

COMBINED CONDENSATE from the various wells flows to blowcase pictured here.

Reservoir Characteristics

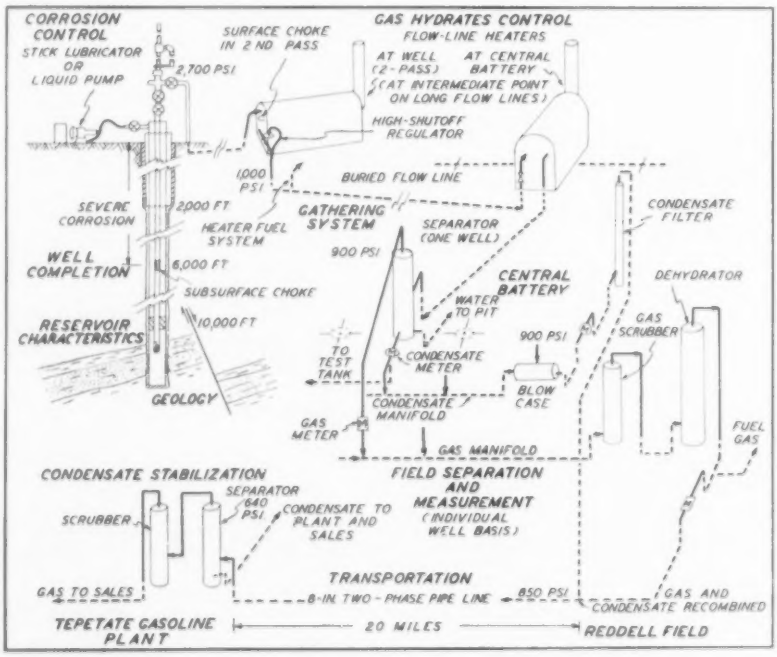
The producing zones are firm medium-grained sands with considerable amounts of calcareous material and varying shale content. Average net pay thicknesses are 18 ft. in the Tate and 12 ft. in the Haas. Porosity averages 22 per cent, permeability 90 md. in the Tate and 42 md. in the Haas, and connate water an estimated 30 per cent. Productive limits are defined by faults and in edge reservoirs by salt water.

The hydrocarbons originally in place in the sands were in the gaseous state under original reservoir pressure of 4,600 psi. and temperature of 220° F. The condensate yield when separated at 1,000 psi. and 80° F. was about 125 bbl. of 60°-gravity condensate per million feet of gas, or a gas-oil ratio of 8,000 cu. ft. per bbl. This relatively rich gas was originally at or very near dew-point conditions.

Gas cycling was considered early in the life of the field. With fluids of this type retrograde condensation of liquids takes place when pressure falls below the dew point. If this condensation occurs in the reservoir the liquid wets the relatively dry sand and becomes to a large extent unrecoverable. By injecting dry gas into the reservoir, condensation can in many cases be reduced or prevented through the combined action of maintained pressure and the elevated dew-point pressure of the diluted gas. A detailed study at Reddell revealed that, although condensate recovery might be increased by 50 per cent through cycling, such a program would be uneconomical. Each of the numerous independent reservoirs cycled would require an injection well; the costs of drilling these wells and installing and operating the necessary compressors and plant facilities would be greater than the revenue realized from additional condensate recovery.

Production History

Cumulative production from the field through April 1953 was about 300,000 bbl. of condensate and 4.5 billion cubic feet of gas from the Haas sand, in addition to 2 million barrels of condensate and 25 billion cubic feet of gas from the Tate. Pressures have declined unevenly in the separate reservoirs, with some Tate reservoir pressures now as low as 2,600 psi. Condensate yields also vary considerably from well to well with



FLOW SCHEME and operation highlights of Reddell field, Evangeline Parish, Louisiana.

THE AUTHOR

Dennis E. Gregg is production engineer, southern region, for Continental Oil Co. He received petroleum engineering degree from Colorado School of Mines in 1950 and joined the Continental organization following graduation. Until recently, he was petroleum engineer in the South Louisiana district.

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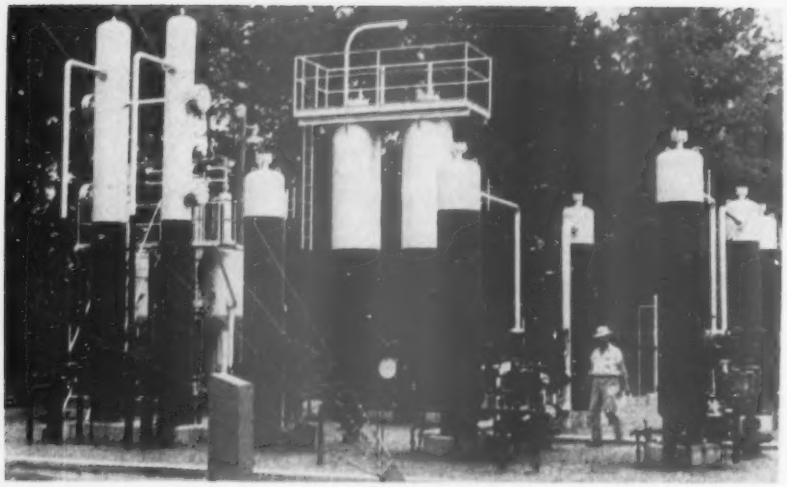


VERTICAL HAY TANKS (left) are used at Reddell field's central battery to filter combined condensate stream before transmission to Tepetate plant. GAS DEHYDRATORS (center, with walkway) are used at the central battery to dry the combined gas stream.

gas-oil ratios as high as 35,000 to 1. now being recorded.

A water drive of some effect is evidenced by the performance of wells which have ceased to flow against system pressure. Even though reservoir pressures were high enough to sustain gas flow, salt water produced with the gas increased the hydrostatic head in the tubing to such an extent that the wells "loaded up" and died.

Daily production from the field now averages about 650 bbl. of condensate and 11,000 M.c.f. of gas, the rate varying with gas-market demand.

Well Completions

Most of the wells are cased with 10¾-in. surface pipe at 2,000 ft. and 6-in. oil string set through the pay zone. Two-inch tubing strings are set on retrievable-type hook-wall packers above the production perforations, and most strings are equipped with subsurface choke seating nipples about 6,000 ft.

The christmas trees have two master valves and a hammer union adapter for attaching a wire-line lubricator. A barbed-wire fence around the concrete well foundation completes the surface equipment at a well. With the wide well spacing and the flat, heavily wooded terrain, the casual passerby might not realize he is in a gas field.

Gathering System

Flow lines from wells to the central separator battery are buried because of the high pressures handled and to afford some protection from freezing trouble in cold weather. Indirect heaters near the wells, at intermediate points in long flow lines, and at the separator battery are designed to keep gas temperature above the hydrate point. The well streams are choked in the well heaters, expanding the gas from well-head pressure to the gathering pressure of about 1,000 psi.

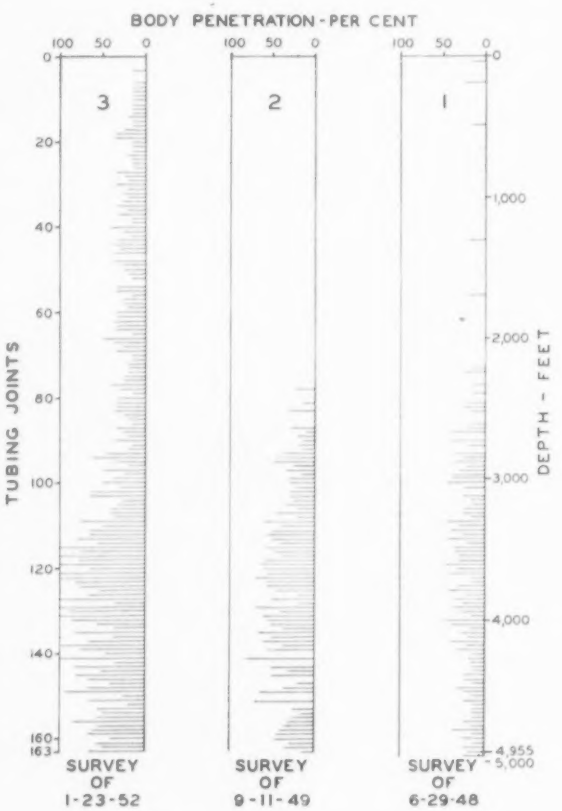
The flow lines are protected from excessive pressures in case of hydrate plugging by high-shutoff regulators at the well heaters. The regulators are so set that the valves close at about 1,100 psi., or 100 psi. above the normal gathering-system pressure. They have proved very useful in enabling personnel at the central battery to shut in the wells from that point. In case of a sudden reduced demand for gas or trouble at the battery, a well can be effectively shut in by closing a block valve at the battery heater. The pressure increase in the line causes the regulator valve to close and saves the operator a trip to the well.

Hydrate Control

The extensive use of flow-line heaters at Reddell is an indication of the importance of gas-hydrate control. At the pressures handled, hydrates form at temperatures as high as 80° F. The first step in hydrate prevention is performed by subsurface chokes. The well effluent, cooled by expansion after passing through the choke, is rewarmed by earth heat thereby reducing surface-heating requirements. Further reduction to gathering-system pressure is made by choking in the well heaters. In wells without subsurface chokes the larger pressure drop through heater chokes requires high heater capacity.

Freezing in the heater chokes is avoided by installing the chokes within the water bath of the heater. It was found at Reddell that even this precaution was not foolproof because small hydrate particles, formed in the tubing or flow line ahead of the heater, would temporarily plug the chokes. This trouble was remedied by installing two-pass tube bundles in the heaters and using the first pass to preheat the gas before choking in the second pass.

Another problem in indirect heater operation, which although seemingly minor can be the weak link in heater performance, is fuel-gas supply. For isolated heaters the logical source of fuel gas is the flow line. However, wet gas expanding from a flow line pressure of 1,000 psi. to burning pressure of 5 to 10 psi. is obviously susceptible to freezing trouble. The fuel-gas system on Reddell heaters is so



CORROSION ATTACK in oil-well tubing string is shown by these results of successive caliper surveys obtained from a Reddell field well. This tubing string was replaced in 1952.

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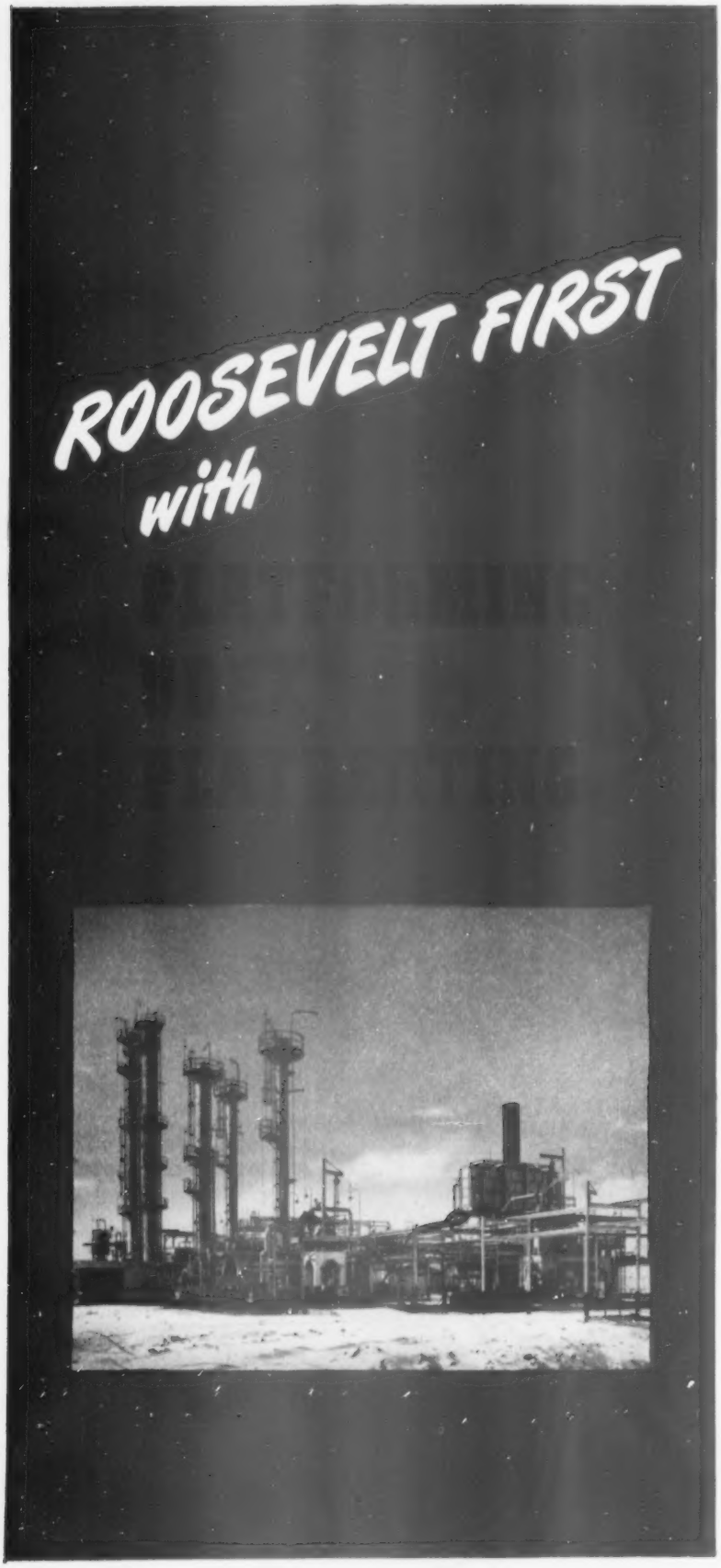

NEW PROCESSES EXPAND MARKETS FOR ROOSEVELT OIL

By J. E. Boudler,
President
Roosevelt Oil and Refining Corporation

Installation of three new Universal Oil Products Company's facilities has enabled our refinery to enter the premium gasoline market for the first time while simultaneously helping us to expand substantially our present line of specialty naphthas and solvents.

J. E. Boudler

Roosevelt put on stream in January a UOP Platformer, a Udex unit and a unique hydrogenation process called a Platreater. The latter facility has made it possible for us to supplement our aromatics production from the Udex unit by refining aromatic concentrates from which it previously had been impossible to recover pure benzene and toluene.

The premium gasoline we are now marketing under the brand name of "Power-flight" has received wide acceptance in our trade territory of north central and northern Michigan. We are happy to present to our motoring public this unusually fine, well balanced gasoline.

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Roosevelt's Platformer has a design capacity of 1,800 barrels per stream day when producing motor fuel Platformate. The charge rate on the benzene-toluene operation is 1,200 barrels per stream day, from which total 400 barrels per stream day of aromatics are produced.

The Platreater, operating continuously by excess hydrogen from either of the Platformer's operations, is producing 250 barrels per calendar day of aromatics.

The Platreater is the first of its kind in the world to be operated commercially. Roosevelt buys aromatic concentrates used in the Platreater from chemical companies. These distillates are by-products of ethylene production by high severity thermal cracking.

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I am sure a brief technical discussion of the Platreater's operation will be of interest to readers.

After the aromatic concentrates are delivered to our refinery by truck, they are pumped from storage tanks to a prefractionator, where a sidecut which makes up the Platreater charge is made. This sidecut is mixed with a gas stream, preheated through heat exchangers, then pumped to a catalytic reactor.

The product goes to a cooler, a separator and finally to a stabilizer column for stabilization to C_6 and heavier bottoms. The bottoms go to the Udex charge tanks, which contain the product of the Platformer's benzene-toluene operation. A combination of the two products forms the feed stock for the Udex unit.

From the Udex charge tanks, the feed stock is pumped to an extractor. There contact is made with the solvent which contains diethylene glycol, which removes aromatics from the feed stock. Non-aromatic raffinate goes through a water wash to storage.

The solvent containing the extracted aromatics is sent to a stripping column, where the aromatics are recovered. The aromatics are sent to a water wash and a clay treater and benzene and toluene are recovered individually as overhead products in subsequent fractionators.

Refinery Handles 7,000 b/d

Our refinery is processing 7,000 barrels of Michigan crude a day. In the benzene-toluene operation, we are using a Platformer feed stock having a boiling range of about 150 to 225 degrees F. Materials which have a boiling range of 225 to 400 degrees F. are used when the Platformer is operated for motor fuel production.

Construction of all new units was handled by Procon Incorporated. A central control room, which simplifies operation of the new units, as well as a large graphic panel showing the successive flow through each unit, is an important feature of the new installation. In addition, Procon built roads, erected fences and helped to install transfer piping between all the new units and existing facilities as well as piping to a new tank farm.

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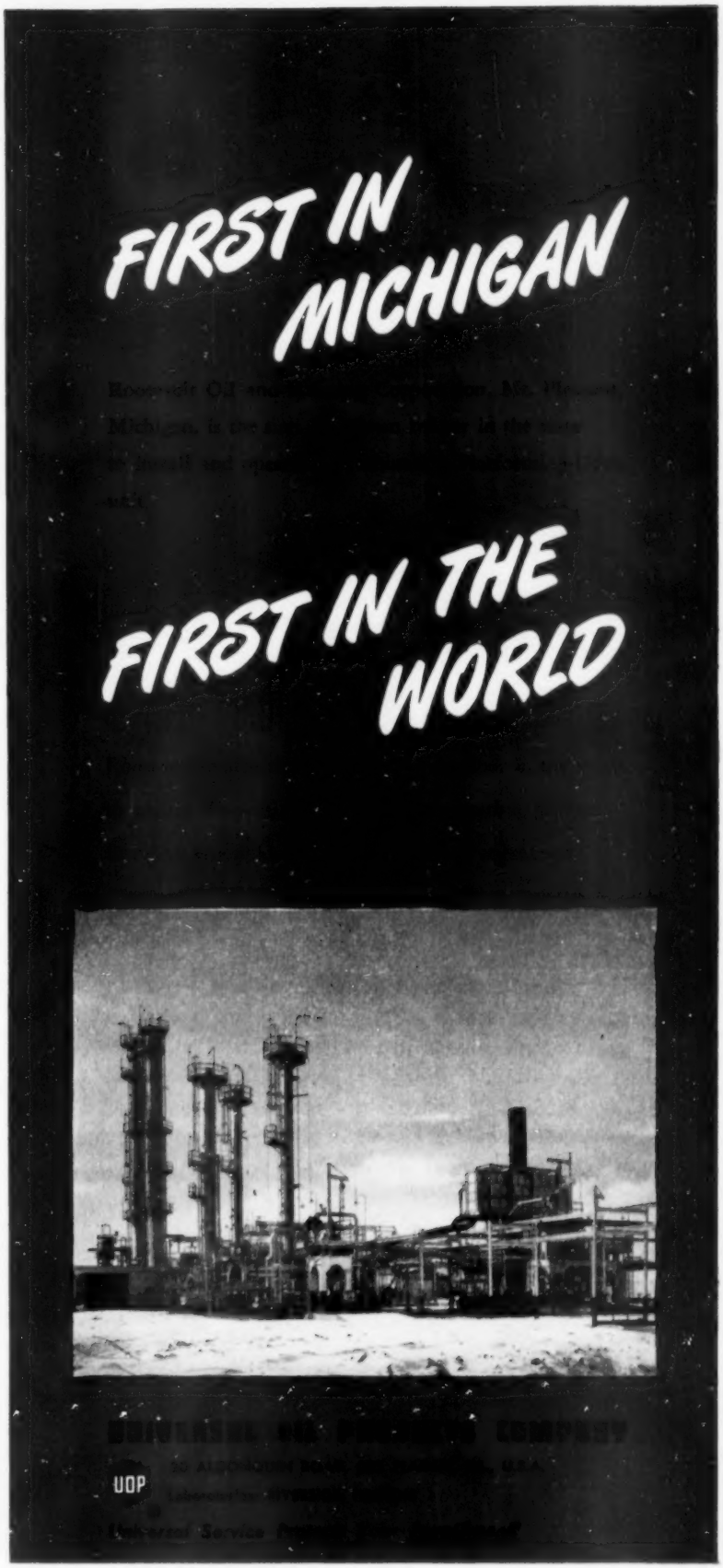
In addition to producing superior aromatics and motor fuel Platformate, we are adding raffinate to our present line of specialty naphthas and solvents as specialty products.



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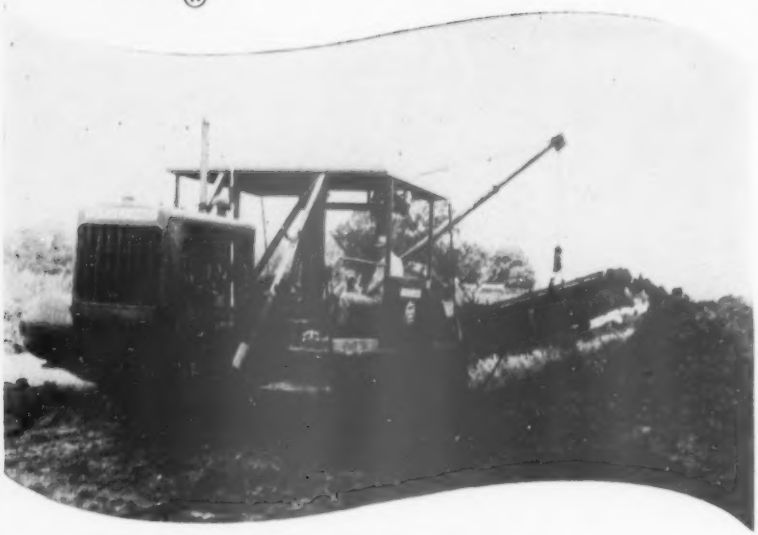

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Corrosion Control

Another problem practically synonymous with high-pressure gas-condensate production is internal corrosion of tubing and flow lines. Water originally in the vapor phase in the reservoir may condense at the lower temperatures up to the tubing string; even though this water is essentially fresh, sufficient carbon dioxide and organic acids may be dissolved from the gas to create a very corrosive solution at high temperatures and pressures. Unfortunately, subsurface chokes used for hydrate control often aggravate the corrosion problems by lowering the temperature of the gas and hastening water condensation. In addition, turbulent flow above the choke scours the tubing walls free of corrosion products which might otherwise offer some protection against further attack.

Corrosion at Reddell has been detected by several different methods, including iron analysis of produced waters, surface and subsurface exposure of weighed steel coupons, and tubing-caliper surveys. Caliper surveys offer a positive and very graphic means of measuring the advance of corrosion attack. An indication of the magnitude of the problem is the recent expenditure of almost $40,000 for replacing two dangerously corroded tubing strings in Reddell wells. Even more serious trouble could result from blowouts or casing failures.

A field-wide corrosion-control program was initiated in 1952 with two methods of protecting the tubing being used. In wells completed without packers or with known tubing or packer leaks, liquid chemical is pumped into the tubing-casing annulus and produced through the tubing. Wells having effective packers are treated with solid chemical sticks periodically dropped into the tubing, leaving the well shut in long enough to allow the sticks to drop to the bottom of the tubing or to the subsurface choke.

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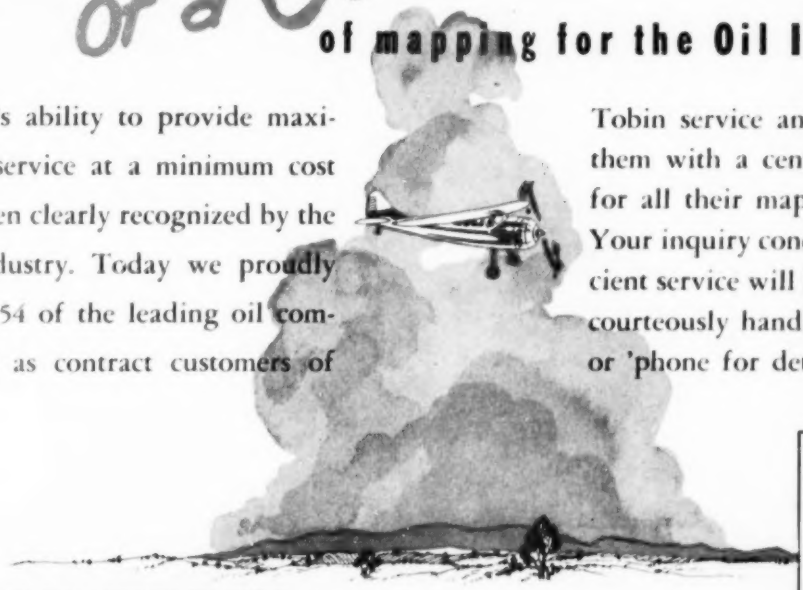

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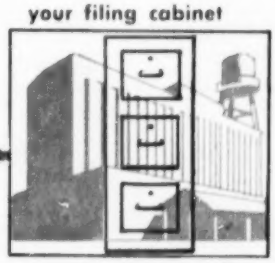

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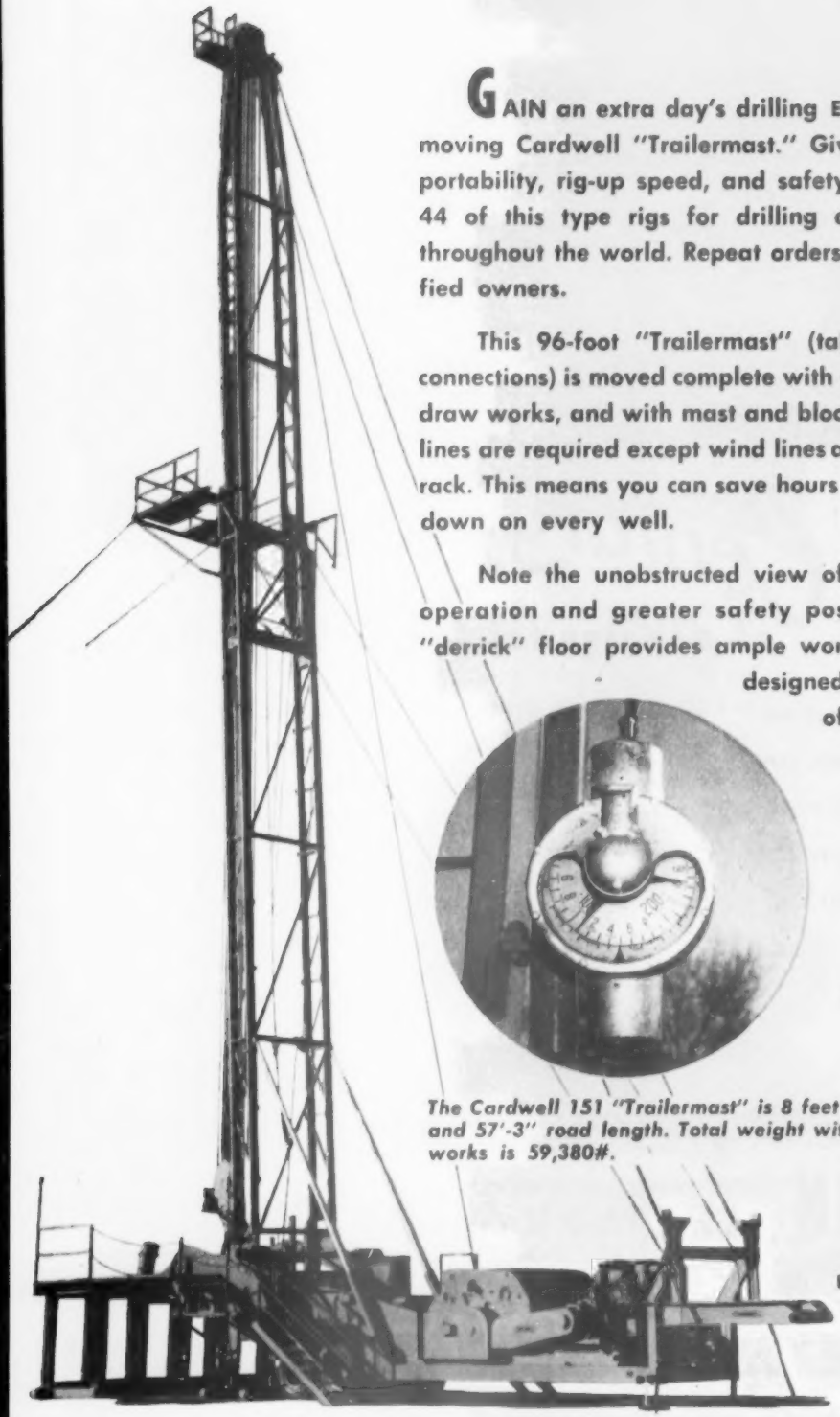

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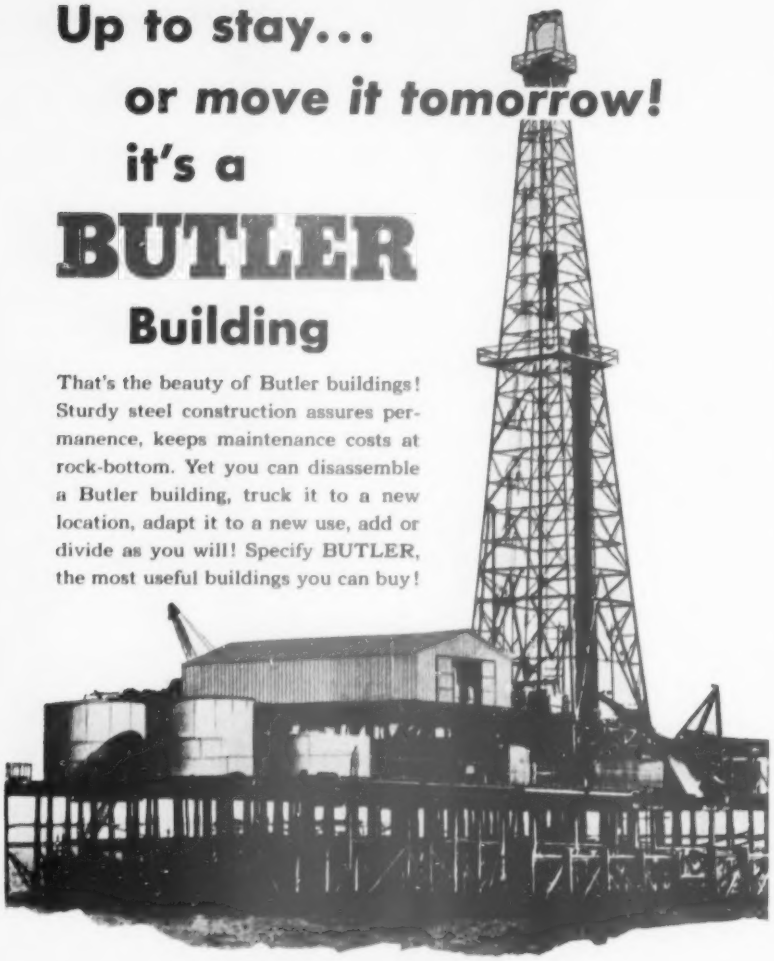

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decreasing iron content of produced waters.

Basic Process Design

Several factors contributed to the design of the measurement and processing system for this field. First of all, continuous separation and measurement of each well's gas and condensate production was necessary because every well was assigned an individual production unit; accurate measurement was required for determining royalty payments, etc.

High-pressure separation was needed to allow the gas to flow to sales without compression. This in turn made condensate stabilization desirable because both gas and liquid volume loss would result from flowing high-pressure "wild" condensate directly into a stock tank. Gasoline-plant facilities were also needed for processing the gas and condensate flash vapors.

Continental, operating most of the wells in the field, had a developed market for gas in the Lake Charles industrial area which it was supplying through a pipe line extending to its Tepetate gasoline plant about 20 miles south of Reddell. With a minimum of new-equipment installation the Tepetate plant could process the Reddell condensate and flash vapors.

Utilization of these existing plant facilities was particularly desirable because the unfavorable economics of gas cycling at Reddell made processing at the field unnecessary.

The fundamentals of the system which was designed to meet these requirements are:

1. Individual well separation and high-pressure metering of oil and gas at Reddell;
2. Recombination of gas and condensate after measuring, and transportation to Tepetate in a two-phase pipe line;
3. Condensate stabilization and flash vapor processing at the Tepetate gasoline plant;
4. Transportation of gas to market through the pipe line from Tepetate to Lake Charles.

Field Separation and Measurement

The separator battery is operated by Continental and serves all of the wells in the field except those recently completed by Pan American. The separators are 24-in. by 11-ft. vertical vessels with 1,000-psi. working pressure. The gas off each separator is measured by a recording orifice meter before entering a common manifold. The total gas stream passes through a vertical scrubber where entrained liquids are removed, then is dried in a solid-desiccant-type dehydration unit.

Gas for battery heater fuel and other uses is metered and the remaining

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Developed and perfected to meet the urgent need for maximum stabilization with today's high drilling speeds, and heavier weights encountered in deep well drilling, the *new* Security Neo-Red Rubber Stabilizer introduces a field-proven method of stabilization that is unsurpased in safety and efficiency.

Briefly, the Security Neo-Red Rubber Stabilizer consists of a 6-foot integral forged steel mandrel with an 18-inch rubber sleeve mounted on the recessed portion of the mandrel. The circular sleeve consists of an oil and temperature resistant rubber moulded over two forged-steel half sections. The metal portion of the sleeve fits inside the recessed portion of the mandrel, with only the rubber extending past the O. D. of the mandrel.

The rubber sleeve floats on the mandrel, providing a wide surface contact to the hole wall, thereby resisting any lateral movement of the drill collars. Stabilizer is easily mounted in drill-string and sleeve can be changed in a matter of minutes right at the rig by only one man. No welding or special tools are required to change sleeves.

Write for Bulletin 130

A multi-colored 4-page bulletin describing the new Neo-Red Rubber Stabilizer in full detail is available upon request. Send for your copy today.

Look at these Field-Proven Features . . .

1 FLUTED CHANNELS

Channels on interior of sleeve permit cuttings to circulate without being hung-up. Scalloped channels on cylindrical exterior insure full circulation, prevent mud and cuttings from lodging between sleeve and formation. Sleeve floats on mandrel, performs no cutting action.

2 FAST CHANGE OVER TIME

Each of the two lightweight sleeve sections has metal tongue and groove to facilitate ease in mounting and removing sleeve right at the rig. Sections are securely joined by seven studs on each side.

3 SOLID ONE PIECE MANDREL

Cut from solid steel forging for maximum strength and safety, this 6-foot mandrel has recessed area for mounting rubber sleeve firmly in position.

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Please send me at once, bulletin on the Security Neo-Red Rubber Stabilizer

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Name_____
Address_____
City_____ Zone____ State_____

28-SC-1

4,211,302 FEET . . .
down the hole

The figure itself isn't too important. But industry's use of this record amount of a single size production string of Chester Welded Casing last year points out a significant fact: that Chester Steel Pipe is dependable pipe. Behind it stand 54 years of experience and expanding production facilities . . . 54 years of proved performance.

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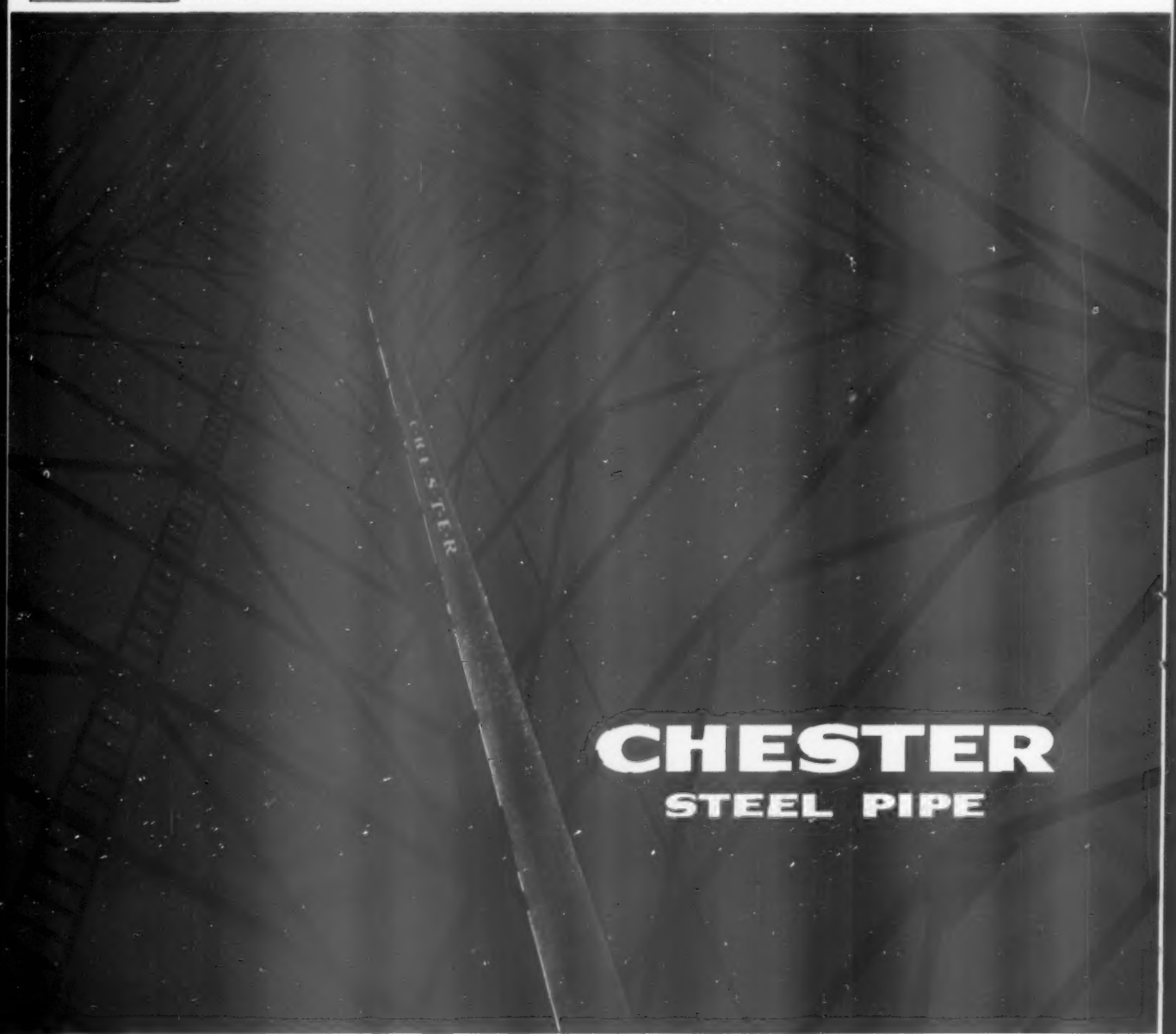

sales gas metered before entering the Reddell-Tepetate line.

Condensate volume from each separator is measured by integrating temperature-compensated positive-displacement meters. The condensate streams are then commingled and flow to a blowcase where separator gas pressure is used to force the liquid into the two-phase pipe line. Before entering the line the total condensate stream is metered, then cleaned in a pair of vertical hay filters.

The volume of condensate metered is greater than that which would be recovered in a stock tank because of dissolved vapors. Monthly stock-tank tests are made on each well to determine a factor for converting metered volumes to stable condensate volumes. A small tank battery near the separators is used for this purpose. The volume of vapors flashed off the condensate in the tank are determined by monthly Hempel tests in which the entire separator-to-stock tank process is simulated with both stable condensate and vapor volumes being measured. The factors thus obtained, when applied to metered volumes, furnish the basis for paying royalty and working interest owners for their share of gas, stable condensate, and flash vapors.

Produced water is drained from the separators into an earthen evaporation pit. Water disposal has not as yet been a serious problem because most of the small volumes produced have been relatively fresh condensed water.

Two-Phase Pipe Line

The 8-in. line transporting condensate and gas from Reddell to Tepetate operates at average upstream and downstream pressure of 900 and 640 psi., respectively. The line has given relatively trouble-free operation. Slugging of liquids collected in low spots was found to cause some liquid entrainment in the gas separated at Tepetate, but this liquid was effectively trapped by installing a scrubber downstream from the separator.

After its final separation from the condensate at Tepetate, the gas bypasses the Tepetate plant and is commingled with gas from other fields flowing to Lake Charles market outlets. Expansion of Continental's Gillis gasoline plant near Lake Charles is now under way which, when completed, will fully process this entire gas stream, including that produced at Reddell. The condensate is stabilized at the Tepetate gasoline plant by two-stage separation before entering pipeline storage tanks. Liquid products are removed from the vapors flashed at each stage, and a maximum of residue vapors are conserved and sold.

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GULF COAST FIELD REPORT

Swan Lake Viewed As Discovery of Major Importance

This report shows the intricacies of the petroleum geology, drilling-development procedures, and production practices that may be involved in a Gulf Coast oil field.

by Emil F. Bowers*
and R. H. Denman†

Fig. 1—Swan Lake: 500 acres, 8 zones, 6,000-8,700 ft.

SWAN LAKE field is situated in Jackson County, Texas. It occurs in the lower south-southwest corner of the county and is 8 miles northeast of the town of Port Lavaca. It is one of a chain of fields along the coast (see Fig. 1), and is 30 miles inland from the Gulf of Mexico.

Swan Lake field derives its name from a saline body of water adjacent to the producing properties. The nearest production of major importance is West Ranch field, 4 miles to the northwest.

The surface topography slopes gently towards Swan Lake. The elevation varies from 27 ft. on the east to about 18 ft. at the bluff bordering the lake. Surface soil is primarily black clay with a few isolated sandy areas to the east. Natural drainage is very poor and the land becomes boggy in wet weather. Absence of normal rainfall during the development program resulted in a minimum amount of difficulty in drilling operations.

Dry holes drilled by earlier lease holders provided control from which a subsurface closure could be postulated. The absence of normal relief on top of the first Frio sand and the numerous well-developed sands which could be expected from 6,000-9,000 ft. led to the drilling of Southern Minerals Corp. 1 Garland T. Brooking, the discovery well.

Drilling operations began February 1, 1950, and reached a total depth of 9,027 ft. on March 8. Five-and-one-half-inch casing was set at 7,360 ft. and initial production of gas and distillate resulted from dually completing the well in the 6,000 and 6,800-ft. zones. Subsequent development proved the 6,000-ft. sand to contain an oil column. The 6,800-ft. gas completion is presently producing.

Some paleontological markers were available from cuttings saved in previous exploratory work. Southern Minerals Corp. had no direct interest in the well cuttings so, except for limited sidewall samples taken in the sands above the Frio, no attempt was made to examine formations above 6,000 ft. Several generalized stratigraphic sections are available from the literature (Table 1).

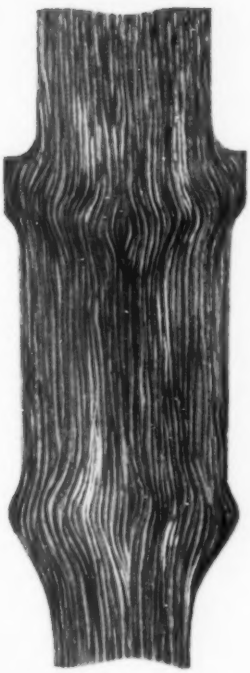
Swan Lake production is situated on

TABLE 1—GENERALIZED STRATIGRAPHIC COLUMN, SWAN LAKE FIELD AND VICINITY

Age	Formation	Lithologic description	Approx. thickness (ft.)
Pleistocene	Beaumont	Black colloidal clay	
Pliocene and Miocene (Undifferentiated)	Lissie	Light-colored clays and fresh-water sands	4,500
	Goliad	Light-colored clays and fresh-water sands	
	Lagarto	Yellow, blue, green and brown calcareous clays with a little sand	
	Oakville	Light-colored bentonitic clays and sands	
		Ashy sands (often referred to as basal Miocene sand)	700
	U. Catahoula Discorbis	Dark greenish gray, brittle, fossiliferous shale	400
Miocene	Heterostegina	Dark greenish gray, brittle, fossiliferous shale	100
Oligocene?	Marginulina	Dark greenish gray fossiliferous shale	100
	L. Catahoula	Shaly sands and clean sand	200
		Unconformity	
	Frio	Green and blue shales and sands	3,700
Oligocene	Vicksburg	Gray, brownish gray and lignitic shales	(?)

Adapted from work of A. J. Bauernschmidt, Jr., A.A.P.G. Bulletin XXVIII, page 200.

*Chief petroleum engineer, and †reservoir engineer for Southern Minerals Corp., Corpus Christi, Tex.



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PR-18

the downthrown side of a regional northeast-southwest fault system. The shallow producing structure is an elongated anticlinal closure with the major axis generally parallel to the regional fault system. Closure results from the reverse dip of the beds into the fault zone, and is in the order of 200 ft. or more on the deeper horizons.

The structure has low relief at 6,000 ft. and is much more sharply defined on the subsequent producing sands, particularly in the deep Frio horizons. With depth, the major axis tends to rotate in a clockwise direction from northeast-southwest to approximately due east-west. The shape of the structure changes from elongated to more nearly round on the middle Frio horizons and then returns to elongated on the basal sands.

No faulting was encountered in the initial development program. However, the fact that the Humble Oil & Refining Co. 1 Hensley had a short Frio section as compared to the Humble 1 La Bauve gave proof of regional faulting.

The initial development program was confined to the sands producing from 6,000-7,400 ft. Subsequent drilling to the basal Frio sands indicated the presence of faulting on the north and west sides of the structure. The reservoir system is very complex. An intricate fault pattern is assumed based on drill-stem tests and production information together with short sections in many of the Schlumberger logs. Due to limited control, several fault interpretations are possible.

The development to 7,400 ft. was carried on during 1950. In that year five oil sands and two gas sands were discovered and limits defined. With the exception of the 6,000-ft. sand the other four oil zones were substantially developed.

According to the Texas State Board of Water Engineers, fresh water sands occur in the Swan Lake area to a depth of 800 ft. The approximate thickness shown in the generalized stratigraphic column is based on the paleontological markers in Humble 1 La Bauve.

In February 1951, The Texas Co. discovered production in the 1 E. C. & W. B. La Bauve below the 7,400-ft. horizon. This well was carried to a total depth of 9,215 ft. and established oil production from the 8,700-ft. horizon. The location was beyond the productive limits of the oil sands to a depth of 7,400 ft. and it defined the producing limits of the deeper sands on the south flank of the structure.

The Swan Lake field development program was completed in December 1951. A recap of the operations of Southern Minerals Corp. and The Texas Co. reflected a total of 30 producing wells and 4 dry holes. Ten of the 14 sands discovered were determined to have commercial oil columns; the remainder are considered to be gas-distillate reservoirs.

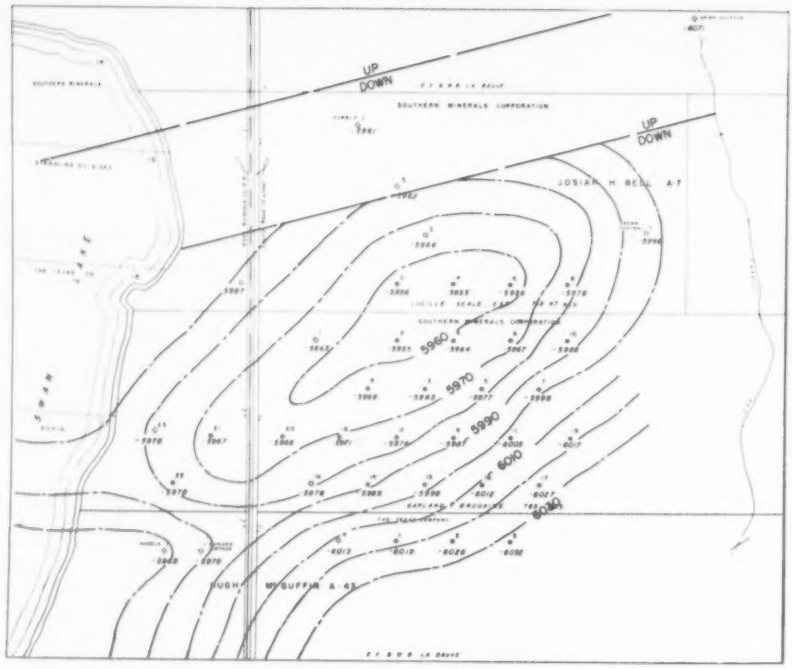

Fig. 2—Contour map of the 6,000-ft. sand.

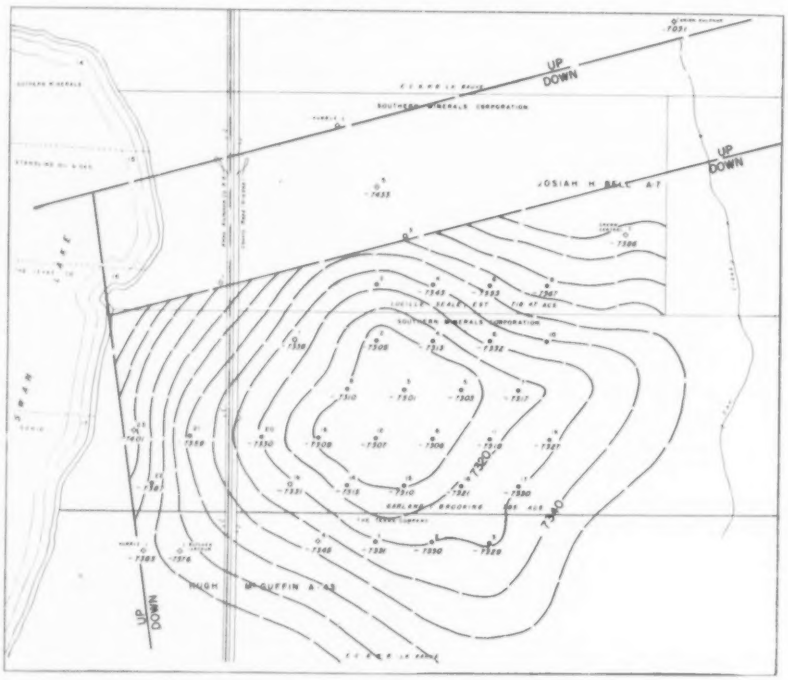

Fig. 3—Contour map of the 7,400-ft. sand.

Two interesting features of the field are its small size and the complexity of the fault system. When it is realized that the field covers in the largest reservoir only some 500 acres, occurring within an area which had been substantially outlined by dry holes prior to discovery, both exploration geologists and management can be encouraged that similar fields are yet to be found in Southwest Texas. Although the field is very limited in its lateral extent, it is a multisand field which offers promise of being a highly profitable operation.

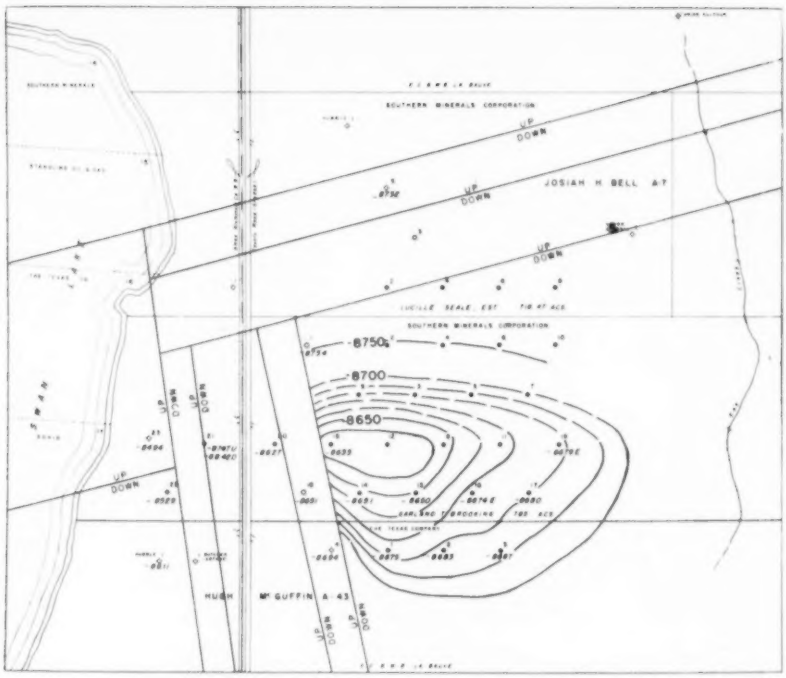

Fig. 4—Contour map of the lower 8,700-ft. sand.

The producing sands vary from mushy and Bentonitic, to dirty and shaly, to alternately dirty and clean, to calcareous, to firm, medium-grained, clean highly porous and permeable. The productive reservoirs vary in size from less than 80 acres to a maximum of 511 acres. Individual oil columns vary from less than 10 ft. to approximately 20 ft.

The structural picture for Swan Lake field can best be understood by contour maps made on producing sands from the upper, middle, and lower sections of the Frio. For this reason maps are included on the 6,000, 7,400, and L-8,700-ft. horizons.

The 6,000-ft. contour map (Fig. 2) reflects the shallow producing structure. The most northerly fault is part of the main regional fault system. This fault has approximately 500 ft. of throw and cuts the Union Sulphur & Oil Corp. 1 La Bauve at approximately 7,000 ft. The second fault is postulated on a difference in water level in Southern Minerals 3 Seale as compared to Southern Minerals 5 Seale and an abrupt change in rate of dip as reflected on the 6,600-ft. sand. On the latter horizon, Southern Minerals 3 Seale is 74 ft. lower than Southern Minerals 4 Seale and 7 ft. lower than Southern Minerals 5 Seale. From the rate of dip between Southern Minerals 4 Seale and Southern Minerals 3 Seale, the latter should have been higher instead of lower than Southern Minerals 5 Seale.

The 6,000-ft. zone can best be described by results of drill-stem tests taken in the discovery well. Three drill-stem tests of the interval 6,001-23 ft. were found to be nonproductive although gas odors were found in the bentonitic sand cores. A commercial gas test resulted in the interval 6,023-28 ft. High-ratio oil tests occur in the interval 6,029-33 ft. No commercial tests were taken in the interval 6,033-43 ft. and salt-water contact was established in a test from 6,043-50 ft.

The 7,400-ft. contour map (Fig. 3) indicates the change in shape of the structure and the change in direction of the major axis. On this horizon three faults are indicated: The two northeast - southwest faults are the ones previously indicated on the 6,000 - ft. map.

The fault to the west cuts the Humble 1 La Bauve about 125 ft. below the 7,400 - ft. sand datum. It has about 100 ft. of throw at this depth.

Perhaps the sand of greatest academic interest although of least commercial value is the L-8700-ft. zone (Fig. 4). In addition to the two northeast - southwest faults shown on the 7,400-ft. sand map another fault has been added between these two. This fault cuts Southern Minerals 5 Seale at approximately 8,000 ft. and it has a throw of 60 ft.

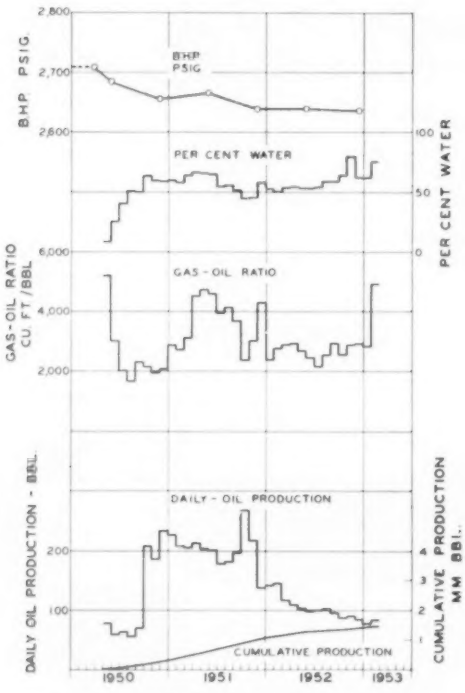

Fig. 5—Reservoir performance, 6,000-ft. sand.

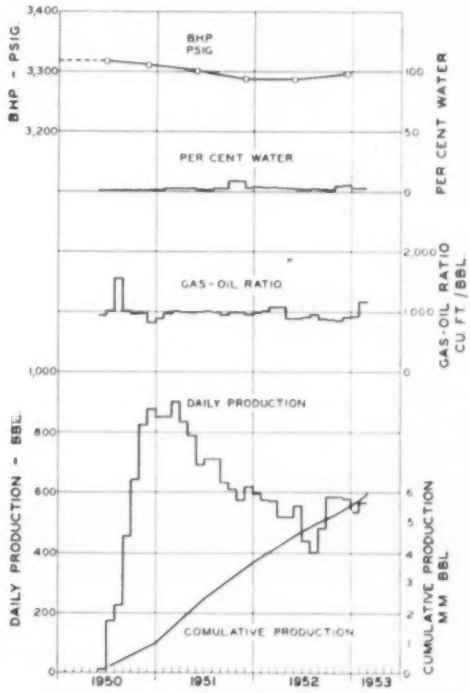

Fig. 6—Reservoir performance, 7,400-ft. sand.

Eastern States Platforming Unit—
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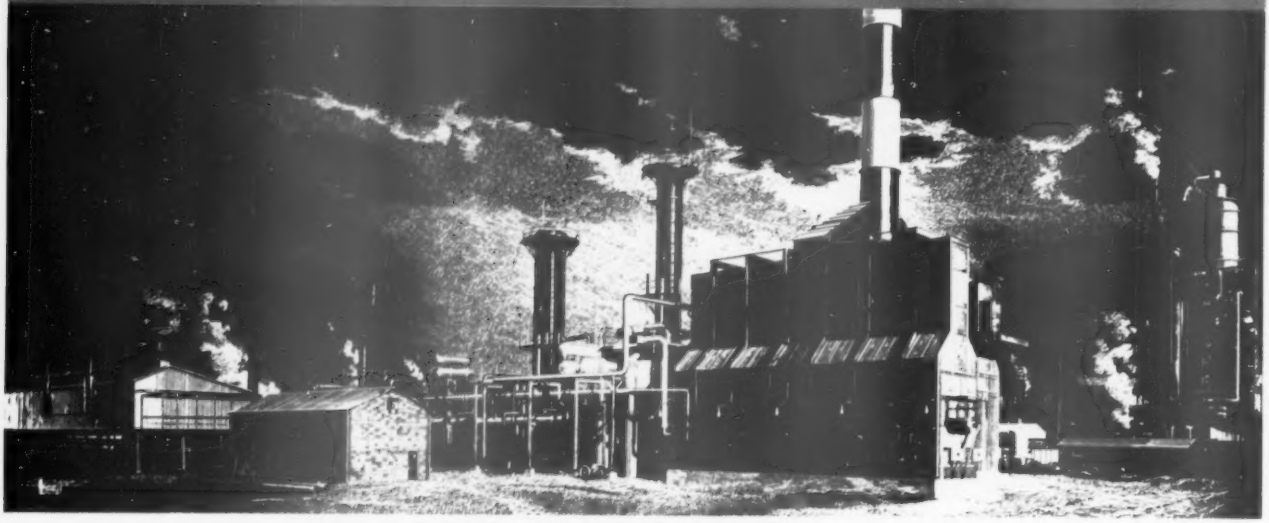

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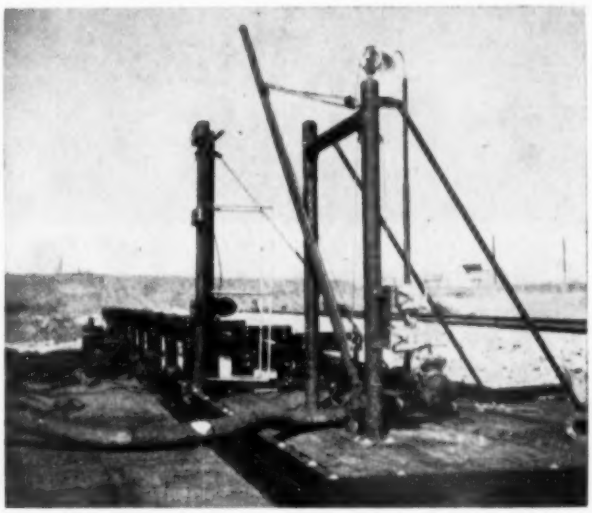
. . . Loading Oil at Swan Lake Field

1. FROM TERMINAL STORAGE TO DOCK (8-in. line)—Alcoa's Point Comfort plant, which uses the Swan Lake casing-head gas, can be seen in left background.

2. BARGE TOW being loaded at Southern Minerals Corp. Point Comfort terminal. Southern Minerals' field production runs about 2,250 bbl. per day.

3. SPECIAL HOIST for handling 8-in. flexible loading hose.



4. REMOTE CONTROL.—Loading pump started and stopped by push button.

The most westerly fault is the same fault shown on the 7,400-ft. sand map. The next fault cutting Southern Minerals 21 Brooking intersects this well at the sand datum. This fault has a throw of approximately 100 ft. The next north-south fault to the east of Southern Minerals 20 Brooking cuts that well about 200 ft. above the top of the sand and has a throw of approximately 120 ft. The most easterly fault cuts Southern Minerals 18 Brooking at 7,745 ft. subsea and The Texas Co. 4 La Bauve at 8,350 ft. subsea. The magnitude of this fault is 35-40 ft. The northeast-southwest fault indicated between Southern Minerals 22 and 23 Brooking is assumed on the basis of production tests.

Although the reservoir limits as reflected on the L-8,700-ft. sand map may be subject to query, the following facts about the Brooking lease cannot be refuted.

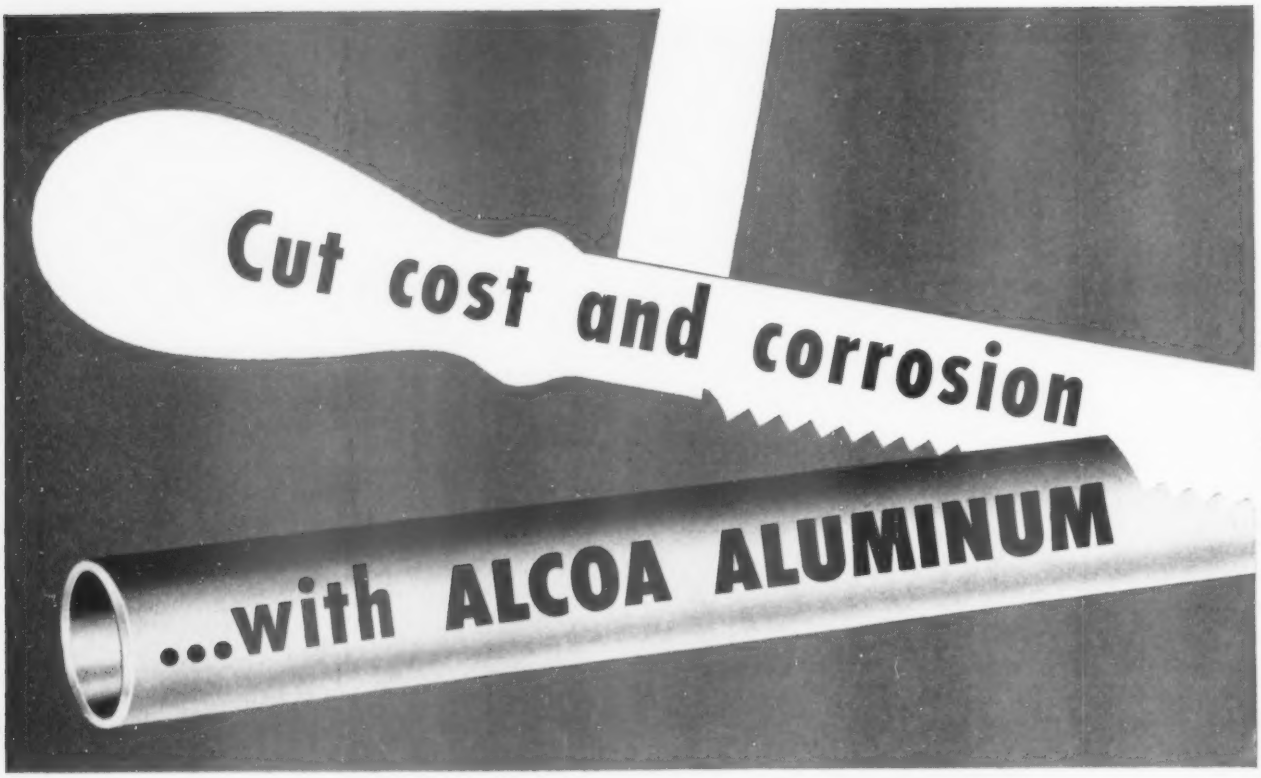
Well No.	Sand top, subsea	Reservoir characteristics
13	8,650	High ratio oil and salt water
18	8,651	Nonproductive
20	8,627	Gas distillate
22	8,529	Nonproductive (productive of oil and salt water in U-8,700 ft. sand)
23	8,494	Nonproductive (nonproductive in U-8,700 ft. sand)

Reservoir Conditions

Table 2 has been prepared as a summary of the bottom-hole sample

TABLE 2—CHARACTERISTICS OF RESERVOIR FLUIDS—SWAN LAKE FIELD, JACKSON COUNTY, TEXAS

Sand—	Bubble point data: Pressure, psig.	Solution GOR, cu. ft./bbl.	Shrinkage	Viscosity: At B.P., cp.	At 14.7 psia., cp.	Gravity at 60° F.: Oil, °A.P.I.	Gas	Bottom-hole temperature, (°F.)	Type sample
6,600 ft.	2,937	782	.700	.34	.85	43.4	.662	180	Recombined
6,700 ft.	2,987	674	.741	.42	.98	41.1	.722	180	Recombined
6,900 ft.	2,959	798	.685	.35	.85	43.1	.785	181	Reservoir fluid
7,400 ft.	3,118	816	.694	.36	.93	41.9	.767	182	Reservoir fluid
7,700 ft.	3,464	963	.656	.297	.876	41.7	.808	194	Recombined



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Ethylene Glycol Monoethyl Ether Acetate
Formaldehyde
Furfural
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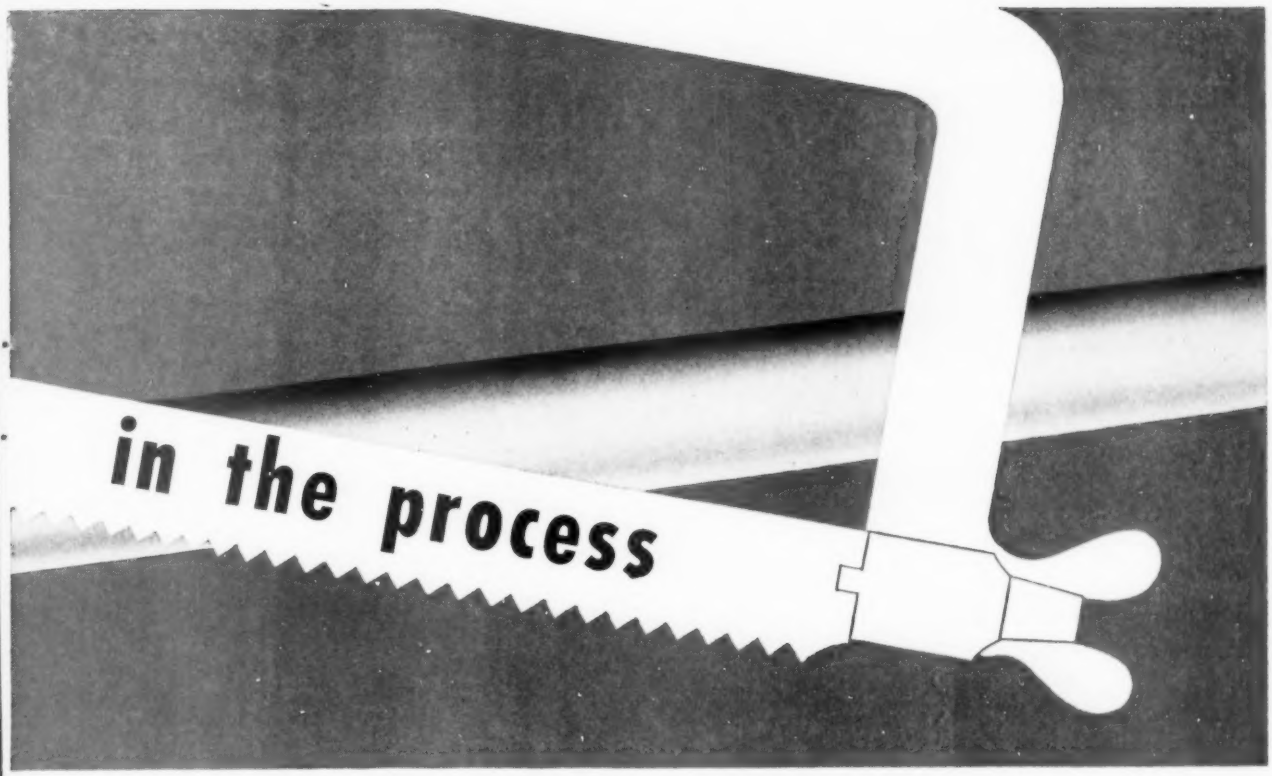

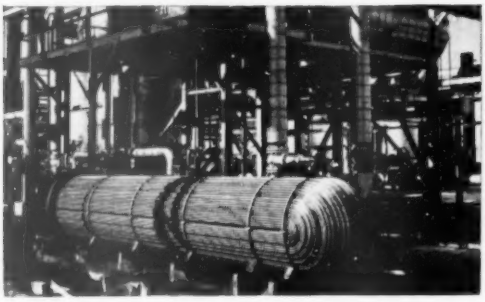

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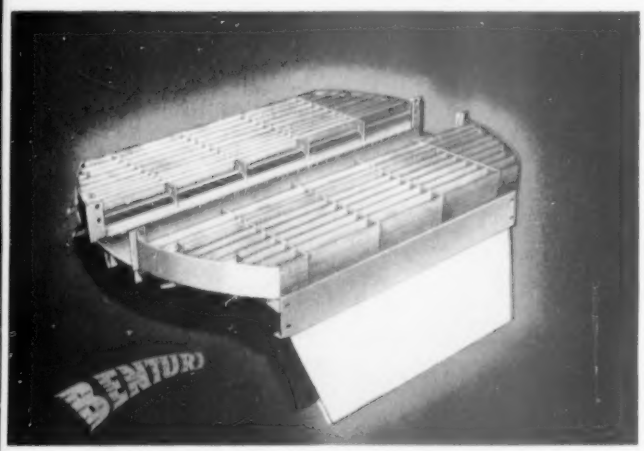

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and recombined sample analyses of the reservoir fluids in those reservoirs of major importance. Main points of interest are that all reservoir crudes were saturated under original conditions, the gravity averages over 40° A.P.I., and the viscosity is low. Bottom-hole pressures (original) were about normal and pressure surveys over the producing months have indicated the presence of active water drives.

TABLE 3—INDIVIDUAL RESERVOIR PRODUCTION

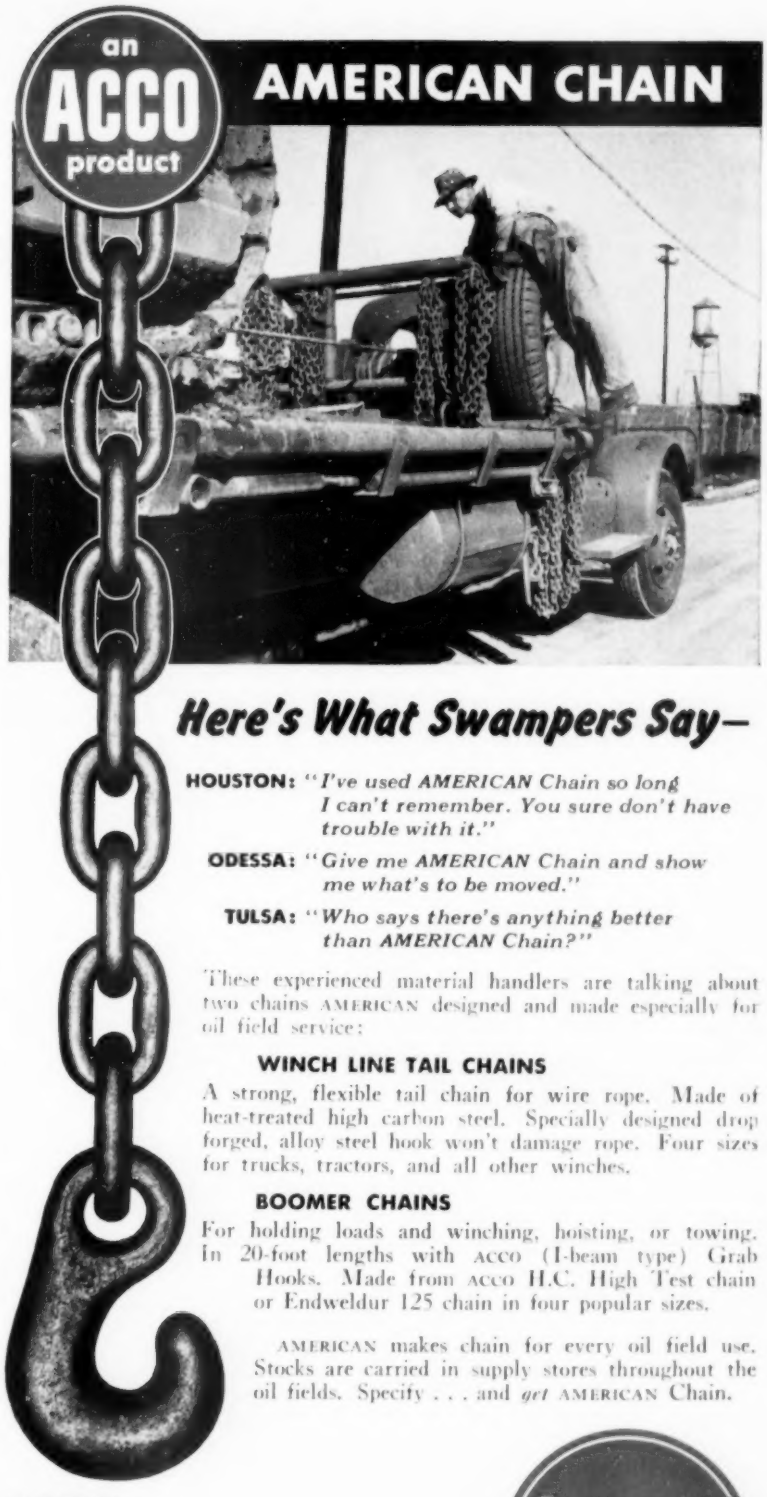
Sand—	Year	Oil, bbl.	Gas, M.c.f.	Water, bbl.
6,000 ft.	1950	28,995	68,062	35,125
	1941	73,554	263,357	101,081
	1952	38,593	101,677	53,193
Total		141,142	433,096	189,399
6,600 ft.	1950	53,909	108,184	3,517
	1951	101,558	177,208	15,592
	1952	92,676	118,695	9,100
Total		248,143	404,087	28,209
6,700 ft.	1950	67,880	48,532	13,193
	1951	208,706	147,029	96,132
	1952	171,856	118,290	86,511
Total		448,442	313,851	195,836
6,900 ft.	1950	83,734	70,153	2,994
	1951	237,421	199,364	18,249
	1952	167,423	134,839	3,589
Total		488,578	404,356	24,832
7,400 ft.	1950	97,400	93,568	0
	1951	265,621	253,709	1,782
	1952	193,991	178,702	4,505
Total		557,012	525,979	6,287
7,700 ft.*	1951	65,174	79,812	0
	1952	116,950	164,398	19
Total		182,124	244,210	19
Upper 8,700 ft.*	1951	10,973	27,493	0
	1952	30,938	55,812	0
Total		41,911	83,305	0
Lower 8,700 ft.	1951	12,141	79,847	8,293
	1952	8,321	100,050	15,695
Total		20,462	179,897	23,988
8,700 ft.†	1951	4,242	2,545	858
	1952	4,023	3,422	85,205
Total		8,265	5,967	86,063

*Southern Minerals Corp. production only.
†22 Brooking.

TABLE 4—TOTAL FIELD PRODUCTION*

Year	Oil, bbl.	Gas, M.c.f.	Water, bbl.
1950	331,918	388,499	54,829
1951	979,390	1,230,364	241,987
1952	824,771	975,885	257,817
Total	2,136,079	2,594,748	554,633

*Southern Minerals Corp. production only.



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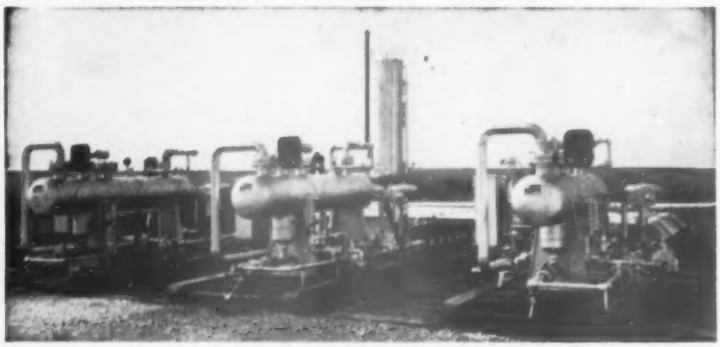

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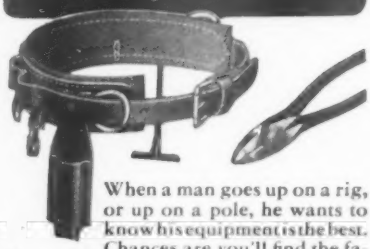

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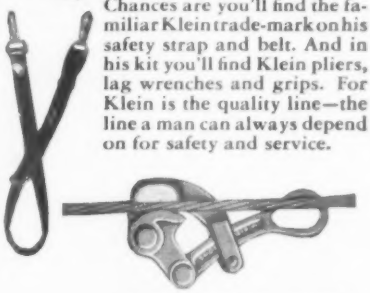

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Two typical reservoir performance curves have been included as Figs. 5 and 6. In most reservoirs the gas-oil ratios are only now showing tendencies to increase and in a substantial number of wells, operation is still at the solution ratio. In those cases where the operating ratios indicate that reservoir gas saturations are above the equilibrium value, MER's have been established which it is believed will permit the optimum ultimate recovery.

Table 3 has been compiled to show the yearly oil, gas, and water production by reservoirs and Table 4 summarizes the total field production by years. The casing-head gas produced has found a ready market as fuel for Alcoa's Point Comfort plant with whom Southern Minerals Corp. shares a dock site on Lavaca Bay. The gravity of the gas ranges from .662 to .808.

Operation of Field

An approximate current water production of 1,800 bbl. per day for the field is collected in a gravity system and run to an open settling pit which also acts as an oil trap. From here the water is discharged into a brackish body of coastal backwater. An enhancing feature is the fact that water disposal in this manner should be possible for the life of the field.

Of the few operating problems encountered in the Swan Lake field, foremost, probably, has been the emulsion-treating and paraffin difficulties. Chemical treatment of emulsions without using heat has met with little or no success, and at the present time an experiment is being conducted using a set of coils in a lease tank through which steam is circulated in an attempt to reclaim tank bottoms.

The paraffin problem to date has been handled by steaming the flow lines where plugging occurs, and a minimum of difficulty has been experienced with paraffin plugging in the tubing.

There are six major producing oil zones. They have an average net effective thickness of 8.2 ft. Table 5 has been prepared to show the average data for the various reservoirs as to permeability, porosity, liquid saturations, etc. The main point of interest in this data is the relatively high values of connate water in some of the sands. In all cases these values were derived from capillary pressure tests run on actual core plugs, and due to the excessively thin oil columns in some sands, the average value was necessarily taken quite close to the free water level. The irreducible value for water saturation is also shown for comparison and in virtually all reservoirs it was the latter value which was used in calculating gas-cap gas reserves.

Average permeabilities are seen to be good and pressure-buildup tests from at least two sands indicate that a 24-hour shut-in time gives quite representative pressures. A check of the distribution index however shows that the uniformity of permeability is only poor to fair for the most part.

TABLE 5—RESERVOIR SAND DATA

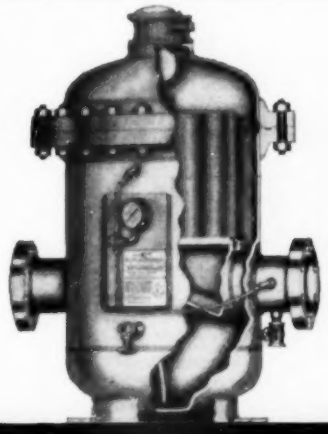
Sand—	Average porosity per cent	Average permeability md.	Average* oil column connate water per cent	Irreducible* water saturation per cent	Net effective oil sand ft.	Gas cap to oil zone vol. ratio
6,000 ft.	36.5	1,032	51	15.0	3.94	.704:1
6,600 ft.	34.59	2,623	22.8	9.0	7.04	.420:1
6,700 ft.	33.41	3,551	19.8	8.0	11.10	.201:1
6,900 ft.	31.16	1,401	36.3	17.2	8.40	.130:1
7,400 ft.	31.78	2,919	21.0	10.6	11.22	.156:1
7,700 ft.	28.84	1,189	29.0		7.61	.368:1
Upper 8,700 ft.	28.47	1,735	35.0		1.72	1.754:1
Lower 8,700 ft.	27.85	3,267	48.0		1.58	4.000:1

*From capillary pressure measurements.

B.H.P.'s . . . From the accompanying curves, Figs. 5 and 6, which are typical of this field's performance, it can be seen that the bottom-hole pressures are being effectively maintained by natural active water drives. For this reason, repressuring or pressure maintenance in these reservoirs will not be necessary. With the thin oil columns overlaid by gas caps, it is anticipated that considerable difficulty will be encountered in the future if withdrawals are not curtailed to match the water influx into the reservoirs. Individual sand MER's consequently have been established, based on past performance, which it is believed will permit maximum production without excessive expansion of the gas caps.

The proximity of the field to coastal waters provides a second advantage in addition to the convenience of brine disposal. This other advantage is that relatively cheap transportation is afforded by barging the oil out to Texas City.

The crude is first run from the individual lease tanks to a field terminal located at Southern Minerals Swan Lake operations center. Here the oil is collected in two tanks, one of 10,000-bbl. and one of 9,000-bbl. capacity. From the field terminal, runs are made through 27,300 ft. of combination 4½



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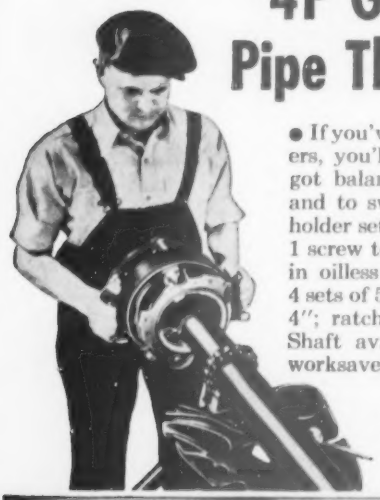

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and 6⅝-in. line to the barge terminal at Point Comfort on Lavaca Bay. Three pumps are available for moving the crude through this line: two are 4 by 10-in. Gaso pumps capable of handling 161 bbl. per hour apiece; the third is a Byron Jackson 3-in. centrifugal pump which has a capacity of 300 to 350 bbl. per hour. At the barge terminal the crude is received in three tanks; two of approximately 20,000 bbl. capacity and one of 48,000 bbl. capacity. A Worthington 8 - LA - 4 volute pump, driven by a G.E. 100-hp., 1,800-r.p.m. explosionproof motor, then delivers the oil to dockside through 2,670 ft. of 8-in. line. Barge loadings are accomplished through an 8-in. flexible hose for which a hydraulic hoist was especially designed for handling during loading operations.

Two features for added convenience and safety are worthy of note: One is the remote control switch at the dock by which the loading pump at the Point Comfort terminal can be started and stopped; the other is that a private telephone system has also been installed between the field terminal, the Point Comfort terminal, and the loading dock to facilitate communication in the event that an emergency develops.

Thus a field of somewhat small size has taken on added importance for its developers as a result of the circumstances and environment under which it was found. The multiple sands available for production, the ease of water disposal, the ready market for its casing-head gas, and its proximity to cheap transportation, have all combined to class Swan Lake field as a "find" of ranking importance in recent Gulf Coast activity.

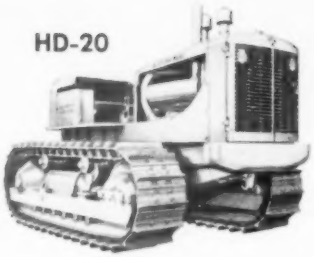
Acknowledgements

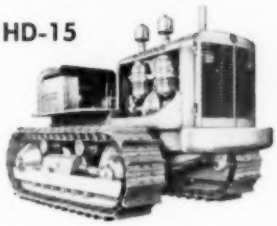
The writers wish to express appreciation to Maston Nixon, president of Southern Minerals Corp., for permission to publish this paper. Also, to acknowledge the information furnished by Southern Pipe Line Corp. under the direction of F. P. Peterson, Jr., and for the assistance furnished by the geological and drafting departments of Southern Minerals Corp.

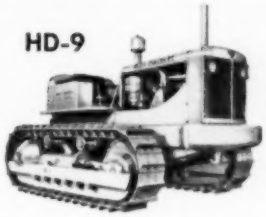
BOOK

A.S.T.M. STANDARDS 1952. Part 5. Fuels, Petroleum, Aromatic Hydrocarbons, Engine Antifreezes. Published by American Society for Testing Materials, 1916 Race Street, Philadelphia. 1253 pp. $10.

Prior to this edition the Book of Standards was issued in six parts. With the extension of society work into new fields the 1952 edition of the Book of Standards comprises over 10,000 pages. To make this amount of material available in books of convenient size and not too bulky and heavy for binding, it was decided to print the standards on bible paper and to publish the 1952 Book of Standards in seven parts. The standards in this volume are assembled in a sequence determined by the specific materials or products to which they apply.







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Yes, the "family circle" of users of Allis-Chalmers tractors is growing constantly. Many users who bought their first Allis-Chalmers tractor only a few years ago now have fleets of them, and many others who operate only one or two tractors have become Allis-Chalmers boosters.

This acceptance is the springboard behind a big plant expansion at Springfield, Illinois, which will enable Allis-Chalmers to meet *your* future needs. See your nearby Allis-Chalmers dealer now for the inside facts on pace-setting tractors that measure up to modern production methods.

Clearing drill sites, building access roads, hauling heavy drill rigs — wherever the jobs are big and tough, this big HD-15 has more than proved its worth. With 109 drawbar hp. and 27,850 lb. weight, it works quickly, efficiently with dozer, winch, tractor-shovel and sideboom.

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This California Co. rig is drilling in Main Pass Block 35 field, Plaquemines Parish, offshore Louisiana. In the course of a year's time, this field achieved a cumulative production of over 900,000 bbl.

Louisiana Offshore Production...

- 22,028 bbl. daily
- 120 oil wells
- 25 gas wells

(mostly shut in)

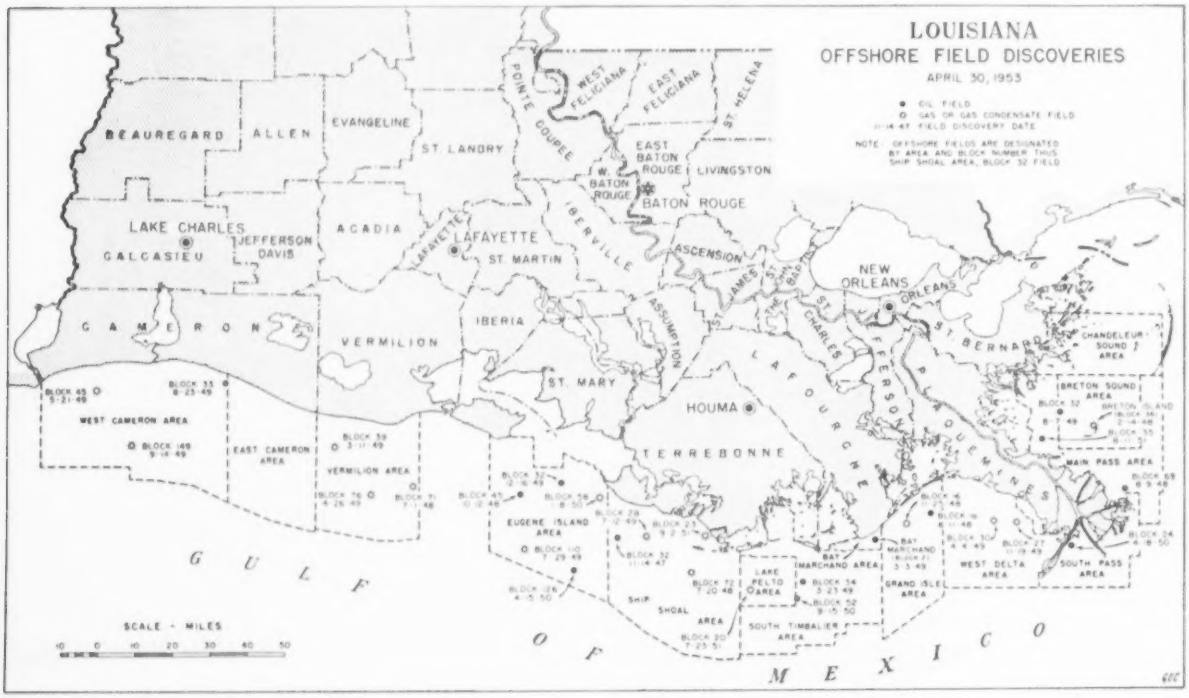
by F. Lawrence Resen
Gulf Coast District Editor

LOUISIANA'S offshore production at the beginning of 1953 was from a total of 120 producing oil wells with a daily production of 22,028 bbl. plus 25 gas wells, the majority of which have been shut in due to lack of gathering facilities.

These wells, which average 184 bbl. per day each, have produced a cumulative total of almost 20 million barrels of oil since the first offshore well was brought in by Kerr-McGee Oil Co. on November 11, 1947, in the Ship Shoal area off the coast of Terrebonne Parish.

By January 1953, a total of 233 wells had been drilled in the offshore areas of Louisiana, resulting in the discovery of an additional 27 oil or gas fields. At the present time, there are 13 companies operating one or more of the fields capable of producing hydrocarbons in these offshore areas.

Exploratory work in the area continued at a relatively high rate during 1948 and 1949 when 7 and 13 field discoveries were made respectively. However, as the tidelands controversy became involved and stalemated, exploration declined and came to a complete halt with four fields discovered



in 1950, three in 1951, and none since.

Most producing wells, as of January 1953, were in Main Pass Block 35 field, Plaquemines Parish, which was opened up in August 1951. Thirty-two producing oil wells with a daily production of 5,205 bbl. were operating at that time and the field has produced a cumulative total of 915,941 bbl. since its inception.

Bay Marchand field, Lafourche Parish, with 26 oil producers and 1 gas well is runner up in number of oil wells. Daily production was 4,244 bbl. daily in January 1953. However, the field, which was discovered in March 1949, leads the list in cumulative production with a total production as of January 1953, of 6,958,489 bbl.

Third in order in number of wells, but second in cumulative production is Main Pass Block 69 field, Plaquemines Parish, with 17 producing oil wells, daily production of 4,845 bbl. and a cumulative production of 5,734,852 bbl. The field was discovered in August 1948.

For purposes of identification and ease of handling reports, the Louisiana Conservation Commission breaks down the offshore area of Louisiana into 14 areas, as follows:

1. Bay Marchand, Lafourche Parish.
2. Breton Sound, Plaquemines Parish.
3. Chandeleur Sound, St. Bernard Parish.
4. East Cameron, Cameron Parish.
5. Eugene Island, St. Mary Parish.
6. Grand Isle, Jefferson Parish.
7. Main Pass, Plaquemines Parish.
8. Ship Shoal, Terrebonne Parish.
9. South Pass, Plaquemines Parish.
10. South Pelto, Terrebonne Parish.
11. South Timbalier, Terrebonne Parish.
12. West Cameron, Cameron Parish.
13. West Delta, Plaquemines Parish.
14. Vermilion, Vermilion Parish.

Production has been obtained in all but Chandeleur Sound area and East Cameron area.

A summary of conditions in each field has been made by the Conservation Commission, which data follow: It will be noted that while most of the report uses January 1953 as the latest reference date, there are a few instances where more up-to-date information has been included on individual field summaries.

Bay Marchand . . . Bay Marchand field was discovered by The California Co. B-1 State Lease 1366, which was completed on March 3, 1949, and has proved to be one of the best producing fields yet found in offshore territory. This field now includes portions of three state leases Nos. 1366, 1367, and 1369 for which the operators paid bonuses of $905,000 and an annual rental of $452,500.

Since the completion of the discovery well, 39 additional wells have been drilled with 29 capable of producing hydrocarbons and 10 which were dry and abandoned. Production in Bay Marchand field has been obtained from depths ranging from 2,500-6,300 ft. and present information seems to indicate that this production is from at least three separate reservoirs.

In 48 months of production the field has produced in excess of 6,900,000 bbl. of liquid hydrocarbons with only a very small increase in over-all producing gas-oil ratio (which is still in most cases below 1,000 to 1), and the tubing pressure in most wells has remained at a good level and in some cases has increased slightly. Until recently, development of this area was proceeding at a rate considerably above normal for offshore areas, and as yet producing limits of the field are not definitely defined in any horizontal direction. All wells operated by The California Co.

NEW FIELDS—1947—OFFSHORE

Name and parish—	Discovery well and completion data
Ship Shoal Block 32, Terrebonne	Kerr-McGee A-1 State Lease 754; comp. 11-14-47, prod. depth 1,734-50 ft.; oil.

NEW FIELDS—1948—OFFSHORE

Name and parish—	Discovery well and completion data
Breton Sound Block 36, Plaquemines	Sunray 1 State Lease 1230; comp. 11-10-48; perf. 4,130-42 ft.; gas.
Eugene Island Block 45, Iberia	Magnolia 1 State Lease 838; comp. 11-10-48; perf. 11,351-58 ft.; gas condensate.
Grand Isle Block 16, Jefferson	Humble A-1 State Lease 799; comp. 11-24-48; perf. 4,565-75 ft.; oil.
Grand Isle Block 18, Jefferson	Humble A-1 State Lease 801; Comp. 8-11-48; perf. 8,640-65 ft.; oil.
Main Pass Block 69, Plaquemines	The California Co. A-1 State Lease 1278; comp. 8-9-48; perf. 5,848-57 ft.; oil.
Ship Shoal Block 72, Terrebonne	Magnolia A-1 State Lease 766; comp. 8-20-48; perf. 7,266-76 ft.; gas.
Vermilion Block 71, Vermilion	Superior A-1 State Lease 884; comp. 7-1-48; perf. 9,608-18 ft.; gas condensate.

NEW FIELDS—1949—OFFSHORE

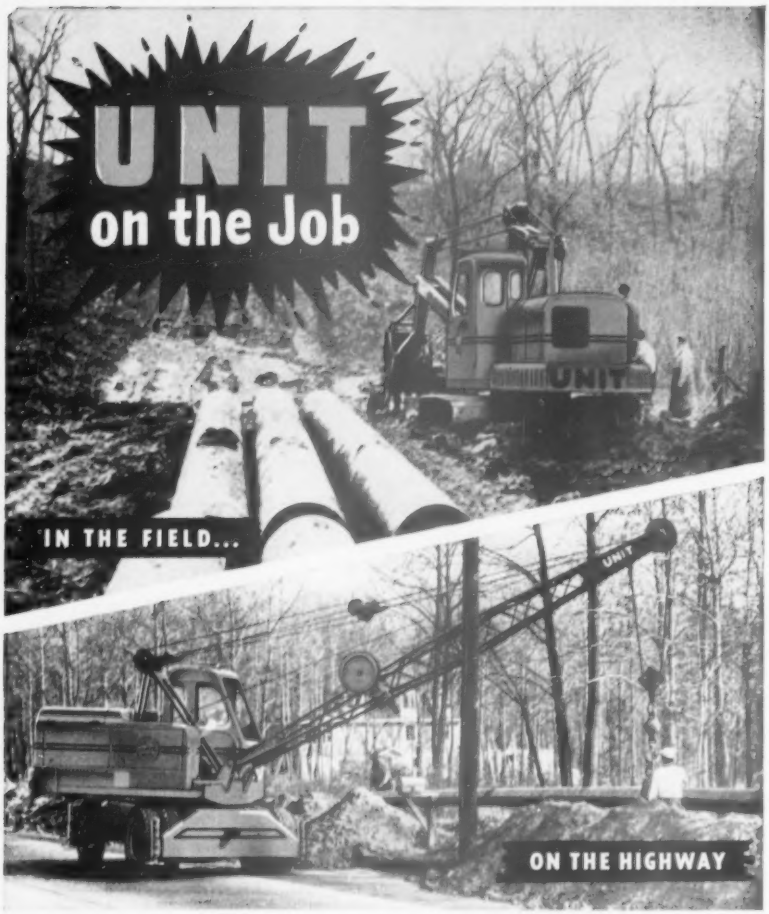
Name and parish—	Discovery well and completion data
Bay Marchand Block 2, Lafourche	The California Co. B-1 State Lease 1366, comp. 3-5-49; perf. 2,873-87 ft.; oil.
Breton Sound Block 32, Plaquemines	Sunray 5 State Lease 1227; comp. 8-26-49; perf. 5,809-12 ft.; oil.
Eugene Island Block 32, St. Mary	Pure 1 State Lease 832; comp. 12-21-49; perf. 9,620-28 ft.; oil.
Eugene Island Block 110, Iberia	Magnolia A-1 State Lease 686; comp. 7-29-49, perf. 9,970-72 ft.; gas condensate.
Ship Shoal Block 28, Terrebonne	Kerr-McGee A-1 State Lease 750; comp. 7-20-49; perf. 8,482-88 ft.; gas condensate.
South Timbalier Block 34, Terrebonne	Humble A-1 State Lease 1027; comp. 3-49; perf. 9,550-58 ft.; oil.
Vermilion Block 39, Vermilion	Pure A-3 State Lease 880; comp. 6-8-49; perf. 8,195-8,220 ft.; gas condensate.
Vermilion Block 76, Vermilion	Superior C-1 State Lease 1006; comp. 4-27-49; perf. 7,415-30 ft.; gas condensate.
West Cameron Block 33, Cameron	Phillips A-1 State Lease 1122; comp. 8-22-49; perf. 10,390-10,410 ft.; oil.
West Cameron Block 45, Cameron	Stanolind A-1 State Lease 1133; comp. 5-21-49; perf. 8,738-48 ft.; gas condensate.
West Cameron Block 149, Cameron	Superior A-1 State Lease 1164; comp. 9-16-49; perf. 5,798-5,834 ft.; gas condensate.
West Delta Block 27, Plaquemines	Humble A-3 State Lease 818; comp. 11-28-49; perf. 9,475-80 ft.; gas condensate.

NEW FIELDS—1950—OFFSHORE

Name and parish—	Discovery well and completion data
Eugene Island Block 58, Terrebonne	Magnolia B-1 State Lease 673; comp. 1-1-50; perf. 11,206-08 ft.; gas.
Eugene Island Block 126, St. Mary	Magnolia A-2 State Lease 649; comp. 4-15-50; perf. 11,648-58 ft.; oil.
South Pass Block 24, Plaquemines	Shell 1 State Lease 1008; comp. 4-18-50; perf. 6,530-34 ft.; oil.
South Timbalier Block 52, Terrebonne	Humble A-3 State Lease 1428; comp. 10-11-50; perf. 12,111-14 ft.; oil.

NEW FIELDS—1951—OFFSHORE

Name and parish—	Discovery well and completion data
Ship Shoal Block 23, Terrebonne	Shell 1 State Lease 1799; comp. 9-2-51; perf. 2,657-62 ft.; gas.
South Pelto Block 20, Terrebonne	Magnolia A-1 State Lease 794; comp. 8-23-51; perf. 8,182-92 ft.; gas.
Main Pass Block 35, Plaquemines	Shell 1 State Lease 1961; comp. 8-11-51; perf. 7,204-09 ft.; gas.



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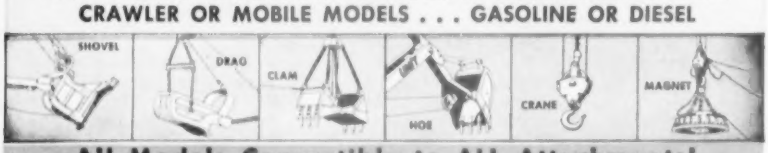

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Breton Sound Block 32 . . . This field was discovered by Sunray Oil Corp. 5 State Lease 1227 which was completed on August 16, 1949. At present producing area of this field is contained entirely within the one lease for which Sunray paid $30,650 with a yearly rental stipulation of $15,325.

Since the completion of the discovery well, four development wells have been drilled, with one oil producer, one gas well, and two dry holes. The development of the field has not been sufficient at the present time definitely to define the producing limits of the field; however, data indicate it probably will not be a large producing area.

In 43 months of production, the field produced 203,067 bbl. of liquid hydrocarbon with a considerable increase in average producing gas-oil ratio. Production is from a depth of approximately 5,800 ft. with all wells operated by Sunray.

Breton Sound Block 36 . . . Breton Sound Block 36 field was discovered on February 14, 1948, by Sunray Oil Corp. 1 State Lease. The field was proved to be a gas-condensate producing area and has never produced because of lack of market outlet for the gas production. Nine other wells were drilled with two shut in as gas wells and seven being dry and abandoned.

Operator paid $81,735 and a yearly rental stipulation of $41,000 for the state lease.

Eugene Island Block 32 . . . This field was discovered by Pure Oil Co. A-1 State Lease 832, which was completed on December 16, 1949. Six additional wells have been drilled in the field. Four are producers and two were dry and abandoned. The wells, which have an average gas allowable of 15,000 M.c.f. per day each, are producing from depths ranging from 10,799-12,125 ft.

The five wells in the field are producing from three different state leases for which the operator paid a bonus of $145,832 with a yearly rental of $72,917. Sun Oil Co. is operator on one well.

Eugene Island Block 45 . . . This field was discovered by completion of Magnolia Petroleum Co. A-1 State Lease 838 on November 10, 1948, as a gas-condensate producer. Four additional wells have been drilled with two oil producers, one gas well, and one dry hole. Daily average production is 392 bbl. with gas well shut in. Magnolia is only operator in field.

Eugene Island Block 58 . . . This field

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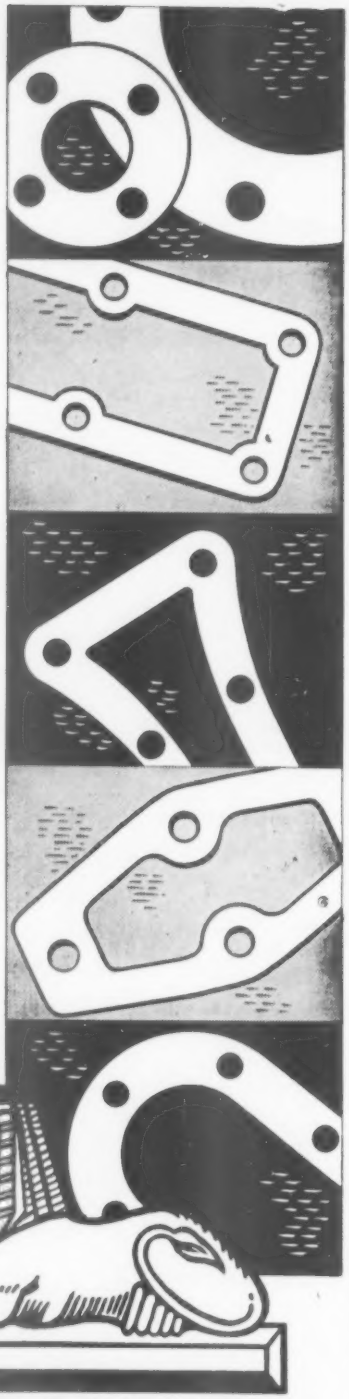

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is located on State leases 670, 673, 676, 679, and 684, for which the operator paid $128,000 plus an annual rental of $64,000. In the early part of 1947, Magnolia Petroleum Co. drilled A-1 State Lease 673 to a total depth of 12,875 ft. with no shows recorded.

The field was discovered by Magnolia B-1 State Lease 673, completed on January 8, 1950, with an initial production of 34 bbl. per day. Seven other wells were drilled with no shows recorded. The discovery well was plugged and abandoned on April 18, 1950.

Eugene Island Block 110 . . . This field was discovered by Magnolia A-1 State Lease 686, which was completed on July 29, 1949, as a gas-condensate producer. Three other wells have been drilled in the field, one gas-condensate producer and two dry holes.

Operator paid a bonus of $102,400 with a yearly rental stipulation of $50,200.

Eugene Island Block 126 . . . This field is located in four state leases for which Magnolia paid a bonus of $102,400 with a yearly rental stipulation of $51,200. Field was discovered by completion of Magnolia A-1 State Lease 693 as a gas well on July 27, 1949. Oil production was discovered on April 15, 1950, by completion of Magnolia A-2 State Lease 694. Nine additional wells have been drilled with five producers and four dry holes.

In 33 months of production history the field has produced approximately 1,140,000 bbl. of liquid hydrocarbons, with a slight decrease in producing gas-oil ratio.

Grand Isle Block 16 . . . This field covers portions of three state leases for which Humble, the operator, paid a bonus of $300,000 and a yearly rental of $150,000. The field was discovered by completion of Humble A-1 State Lease 799 on November 24, 1948. There have been a total of 12 additional wells drilled, most of which proved to be productive of gas with only a nominal liquid content; six were plugged and abandoned.

Liquid production from the field has been erratic, and in a total of 50 months has produced only 54,938 bbl.

Grand Isle Block 18 . . . Completion of Humble A-1 State Lease 801 on August 11, 1948, marked the discovery of this field. Seven additional wells were drilled with four encountering production and three being dry and abandoned. The field is located on portions of four state leases for which

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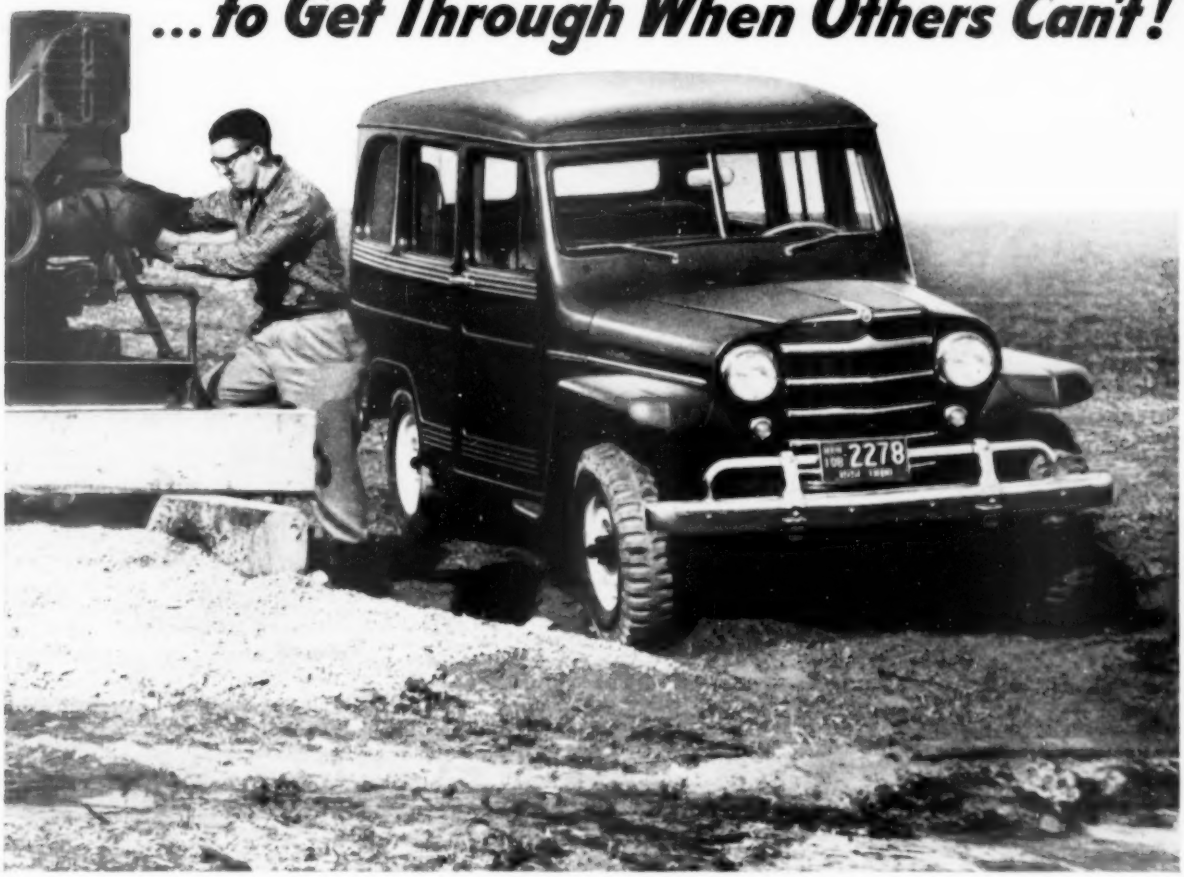

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Humble paid a bonus of $300,000 with a yearly rental of $150,000.

In a total of 54 months the field has produced 1,405,080 bbl. of liquid hydrocarbons from four separate reservoirs. At the present time, all indications seem to favor this field as one of the better producing areas in offshore development.

Main Pass Block 35 . . . Shell Oil Co. 1 State Lease 1961 was completed on August 11, 1951, as a gas-condensate producer and marked the discovery of this field. Subsequent to the discovery well an additional 43 wells have been drilled with 36 oil producers and 7 dry holes. Since the discovery by Shell, three other operators have drilled in the field: The Texas Co., The California Co., and Kerr-McGee Oil Co.

The field takes in a total of 11 state leases for which the operators have paid a bonus of $2,260,461 with a yearly rental of $1,130,230. In the course of 1 year's time, the field has achieved a cumulative production of 915,941 bbl. with February 1953, daily average production standing at 5,762 bbl.

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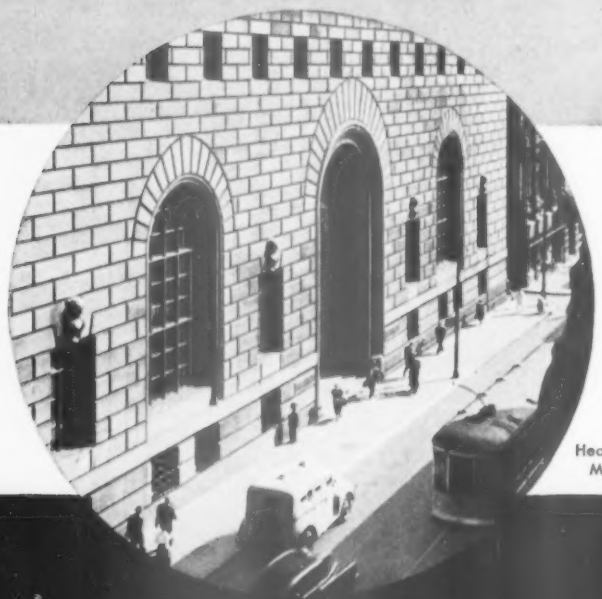

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Main Pass Block 69 . . . Discovery of this field was marked by completion of The California Co. A-1 State Lease 1278 on August 9, 1948. Since completion of the discovery well an additional 19 wells have been drilled with only 2 dry holes.

The field includes portions of four state leases for which the operator paid a bonus of $239,127 with a yearly rental of $119,563. Calco and Shell are the two operators in the field.

In 54 months of production, the field has produced a total of 5,734,852 bbl. of liquid hydrocarbons and it and Bay Marchand field are the only two fields in offshore areas which have produced in excess of 5 million barrels of liquid hydrocarbons. Well data indicate only minor increases in water production with practically no over-all change in tubing pressure. On recent tests, this tubing pressure has actually shown a substantial increase in some wells while producing on the same size choke.

Ship Shoal Block 32 . . . Interestingly enough, the field which opened up offshore production has not faired too successfully. Since Kerr-McGee A-1 State Lease, discovery well, was completed in 1947, nine additional wells have been drilled with one gas completion, four nonproductive wells, and four wells capable of only minor production.

Wells in the field have been completed under four separate state leases for which a bonus of $162,500 was paid with a yearly rental of $81,250.

With a production history of 62 months, this field has produced only 497,545 bbl. of liquid hydrocarbons and at the present time is producing only an average of 214 bbl. per day from the six wells still on production. Well data indicate that most of these wells were completed with high productivity tests, but after a short producing life declined rapidly in ability to produce.

Ship Shoal Block 28 . . . This field was discovered by completion of Kerr-McGee A-1 State Lease 750 on July 12, 1949, as a gas-condensate well. Since there is no market for gas production from this well it has remained shut in and has no production history. Two additional wells were drilled; one a gas well, was shut in while the other was dry and was plugged and abandoned.

Ship Shoal Block 72 . . . Completion of Magnolia Petroleum Co. A-1 State Lease on August 20, 1948, marked the discovery of this field, and was tested as a gas well. Five additional wells

have been completed, with one a shut-in gas well, three oil producers, and one dry hole.

The field consists of State Leases 766, 768, and 755 for which the operator paid a bonus of $60,000 with a yearly rental of $30,000. The field has produced a total of 369,466 bbl. of oil since first oil was produced.

South Pass Block 24 . . . One of the more recent discoveries in the offshore area, this field was discovered by Shell Oil Co. 1 State Lease 1008, which was completed on April 18, 1950, as a small oil producer. Nine additional wells have been drilled and completed as producers in the field with indications that the completed wells are producing from three different reservoirs.

Two state leases are involved in this field for which the operator paid a bonus of $31,692 and a yearly rental of $15,846.

With a production history of 34 months, this field has produced a total of 1,593,504 bbl. of liquid hydrocarbons. The nine wells drilled subsequent to the discovery well have proved to be very good wells, although more production history will be necessary along with additional development before the area can be fully evaluated.

South Pelto Block 20 . . . Field was discovered by Magnolia Petroleum Co. 1 State Lease 794, which was completed on August 23, 1951, as a shut-in gas well. A second well drilled in the field by Humble was plugged and abandoned.

South Timbalier Block 34 . . . Discovered by Humble A-1 State Lease 1027, which was completed on March 30, 1949, as an oil well with good producing characteristics. This well was shut in as a gas well in March 1953. One other well drilled in the field was a dry hole.

South Timbalier Block 52 . . . Following two unsuccessful tests in the early part of 1950, this field was discovered by Humble A-3 State Lease 1428, which was completed on September 15, 1950, as an oil producer. No other wells have been drilled to date.

The wells drilled in this area have been completed under two separate state leases for which the operator paid a total bonus of $164,503 with a yearly rental of $82,261.

Vermilion Block 39 . . . Following two unsuccessful tests in 1948 and the early part of 1949, this field was discovered by Pure Oil Co. A-3 State Lease 880, which was completed as a gas producer on June 6, 1949. Two additional wells

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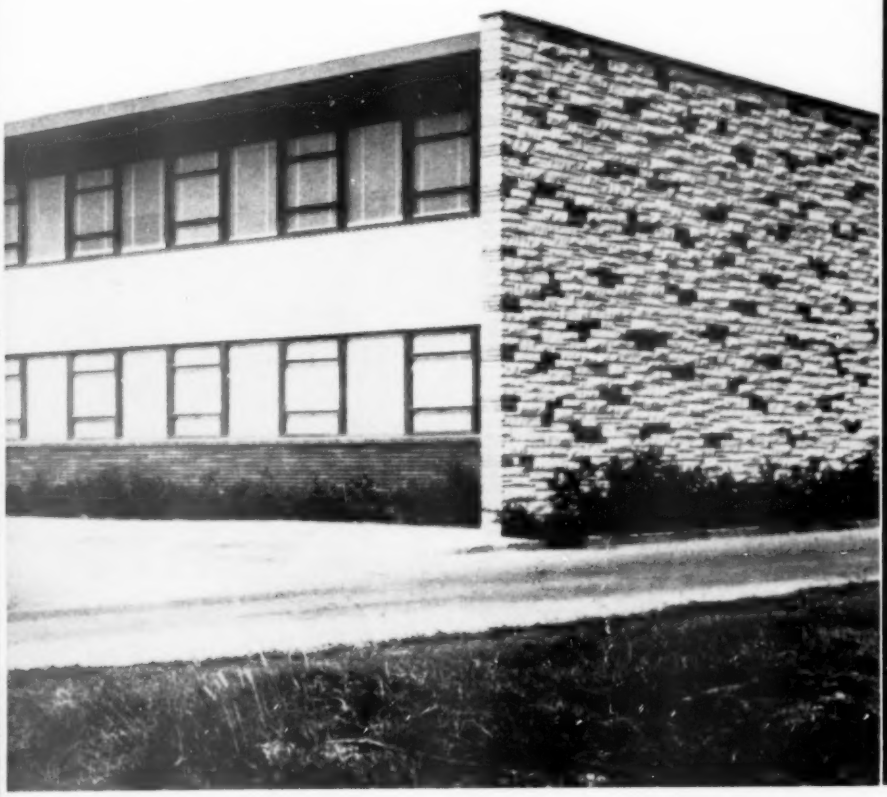

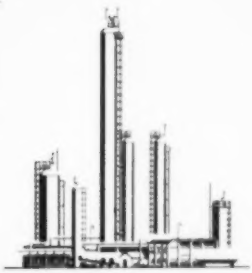

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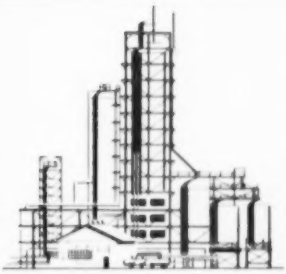

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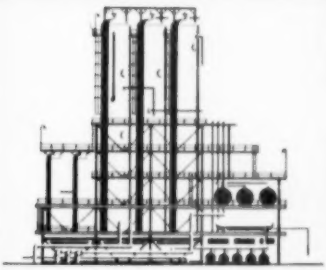

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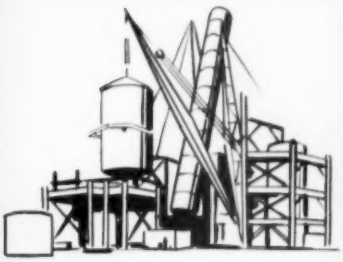

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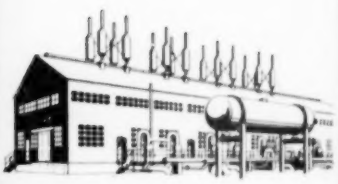


COMPRESSOR STATION

have been drilled and brought in as gas producers. The gas gathered from this field is piped out by Marine Gathering Co., Houston.

All wells are located on State Lease 880 for which the operator paid a bonus of $5,100 and a yearly rental of $2,550.

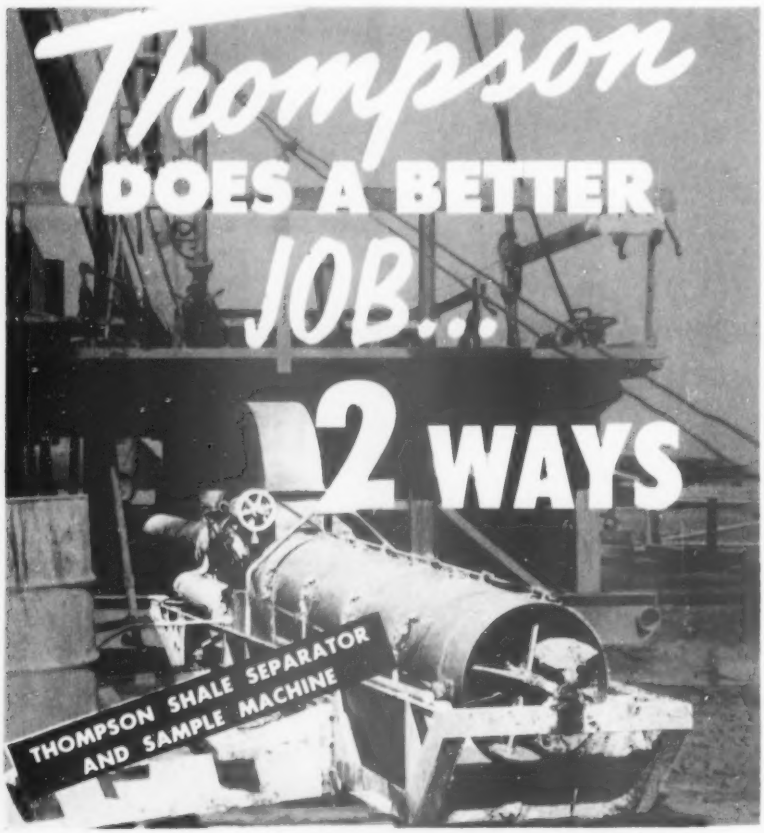
Vermilion Block 71 . . . Discovered by Superior Oil Co. A-2 State Lease after one successful test in early 1948. Later the unsuccessful test well was recompleted and brought in as a gas well.

The discovery well was completed as a gas-condensate producer on November 12, 1948, and has not been produced due to lack of market for gas.

Both wells are located on State Lease 884 for which the operator paid a bonus of $97,434 and a yearly rental of $48,717.

Vermilion Block 76 . . . Discovered by by Superior C-1 State Lease 1106, which was completed on April 26, 1949, as a gas-condensate well. No other development has occurred and there has been no production due to lack of gas market or outlet.

This discovery was under State Lease 1106 for which the operator paid a bonus of $171,550 and a yearly rental of $85,775.



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West Cameron Block 33 . . . Discovered by Phillips Petroleum Co. A-1 State Lease 1123, which was completed as an oil well on August 23, 1949. One other well has been drilled; however, it failed to encounter the productive sand of the discovery well and was completed as a shallow gas sand and shut in.

These wells are completed under State Lease 1123 which was obtained by the operator for a cash bonus of $160,000 and a yearly rental of $80,000.

West Cameron Block 45 . . . Discovered by Stanolind Oil & Gas Co. A-1 State Lease 1133, which was completed as a gas-condensate well on May 21, 1949. Subsequent to this discovery well, another gas-condensate producer has been completed, one oil well has been completed, and one dry hole has been drilled.

Wells of the field are located under three state leases for which the operator paid a total bonus of $176,250 and a yearly rental of $88,125.

West Cameron Block 149 . . . Completion of Superior A-1 State Lease 1164 as a gas-condensate producer on September 16, 1949, marked the discovery of this field. Two additional wells have been drilled and both were completed as gas-condensate producers. Since, as in many other offshore areas, there is no market outlet for this gas production, there has been no producing history from the field with all wells being shut in.

These wells are located under three state leases for which the operator paid a bonus of $349,000 and a yearly rental stipulation of $174,500.

West Delta Block 27 . . . Following an unsuccessful test in May 1949, this field was discovered by completion of Humble A-3 State Lease 818 as a gas-condensate producer on November 19, 1949. One other well was drilled as a dry hole and abandoned. No production history available since well was shut in for lack of gas market.

Well was completed under State Lease 818 for which a bonus of $165,000 was paid by the operator with a yearly rental stipulation of $82,500.

West Delta Block 30 . . . Discovered by completion of Humble A-1 State Lease 819 as a gas well on April 7, 1949. One other well in the field was completed as a gas well and three dry holes were drilled.

State leases involved in the field were acquired for a bonus of $260,000 and a yearly rental of $130,000.

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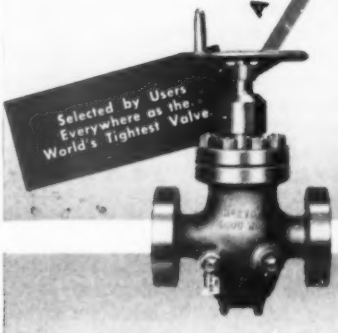

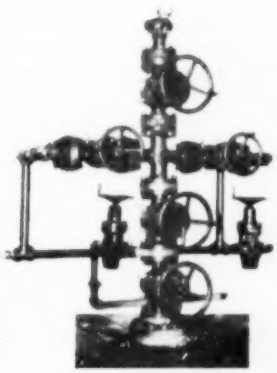

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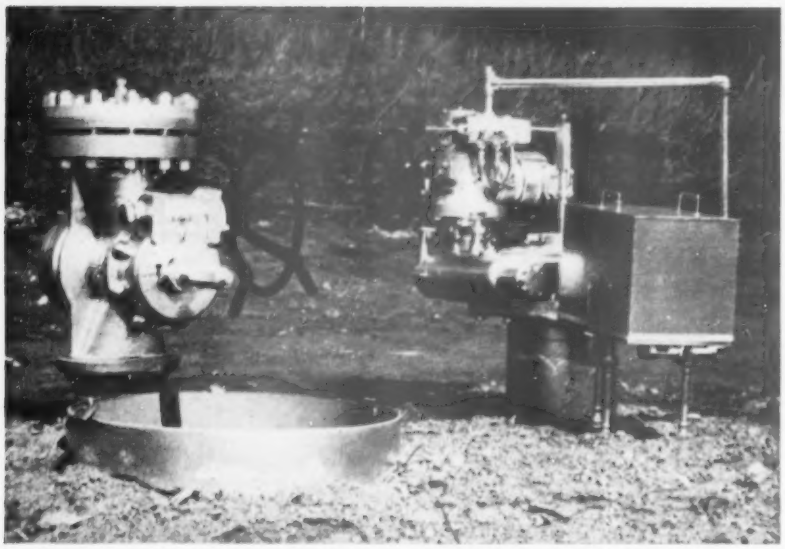


AUTOMATIC BLOCK VALVE closing device shown here is installed on Transcontinental's main line.

Pressure-Rate-Drop Settings for Automatic Shutdown Devices

. . . on gas pipe-line valves

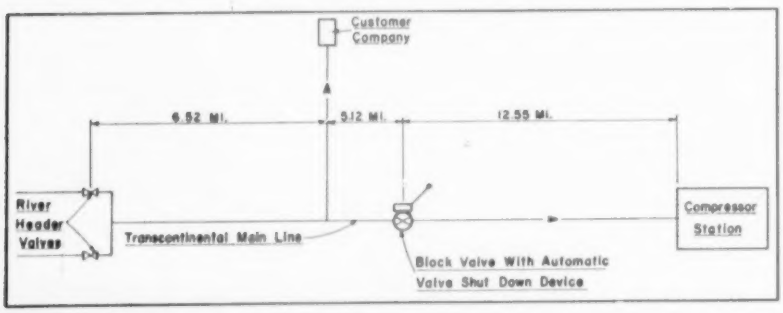
by Gene Proper*

RECENTLY the pipe-line department of Transcontinental Gas Pipe Line Corp. conducted a safety check on its automatic shutdown devices. These are installed on the block valves of the main line in the thickly populated areas of northern Virginia, Maryland, Pennsylvania, and New Jersey to shut down the valves in event of a pipe-line failure.

The pipe-line department set up the check from the standpoint of added insurance against the devices being activated by the most severe conditions even remotely possible under normal operational activities.

For the experiment as shown in Fig. 1 two river header valves were closed, and full delivery was continued to a customer company while the upstream compressor station operated its units at full speed to produce maximum suction. A pressure drop of 74 psi. was produced in the line at the point of the automatic shut down device in 9 minutes, or 8.22 psi. drop per minute. As expected, the device, which is set to require a much larger pressure drop, was not activated.

* Intermediate engineer, Transcontinental Gas Pipe Line Corp., Houston.



SAFETY CHECK on two river header valves on Transcontinental's main line. Fig. 1.

Shutdown systems . . . At present Transcontinental is employing two types of shutdown devices. One, as shown in Fig. 2, was developed by Transcontinental. This device works on a principle of differential created across an oil-field-type choke nipple customarily used for proration purposes at well heads. In the event of a line failure, gas spills from the point of failure at a very rapid rate, creating terrific pressure drop in the line within a few miles of the failure.

Thus immediately following a line failure, a large pressure differential would be set up between the pipe line and the reservoir tank, since gas could not scape as rapidly from the reservoir tank through the choke nipple as it would from the point of pipe-line failure. When sufficient differential is created, a preset spring tension is overcome in the differential pilot. This allows a slug of gas to pass to and open the slide valve.

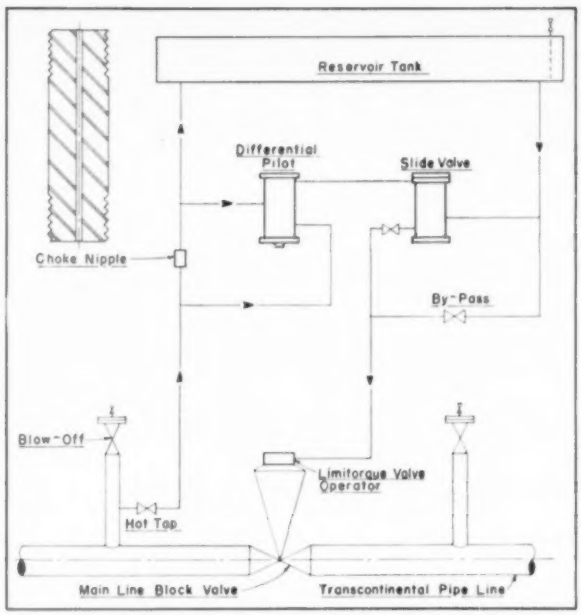
With the slide valve open, gas is able to pass from the reservoir tank to the limitorque valve operator, shutting the block valve. The spring tension setting necessary to require a certain pound per minute drop for activation of the operator was determined by the development of calibration curves plotting pounds per square inch per minute pipe-line pressure drop against pounds of differential pressure created across the choke nipple.

The second device used is distributed by M. J. Crose Co., Inc., Tulsa. As seen in the flow diagram, Fig. 3, it works on the same principle as the Transcontinental device.

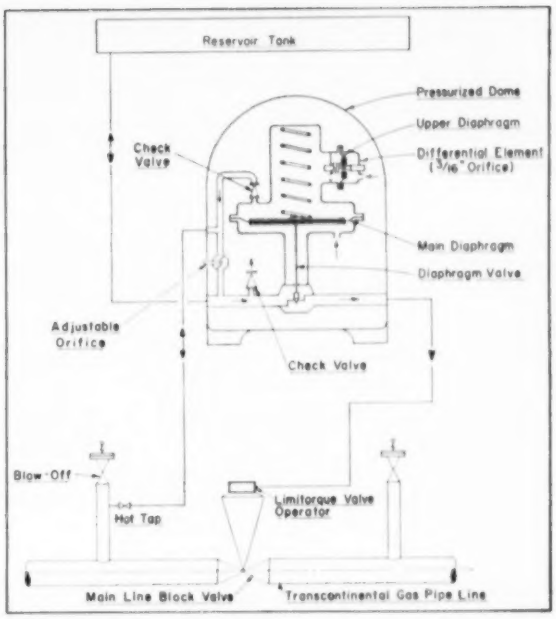
Here again the reservoir tank normally floats on the line through the shutdown device. When a pressure drop occurs in the pipe line, it draws gas from the upper casing of the diaphragm valve and from the reservoir tank through the adjustable orifice. Gas flows from the pressurized dome to the upper diaphragm case through the differential element orifice. Flow through the differential element orifice creates differential across the upper diaphragm until the orifice travels and closes against a ball seat at 2 psi. differential.

A continued drop of pressure in the upper diaphragm casing creates a differential across the main diaphragm sufficient to lift the diaphragm valve from its seat at 4 psi. differential. Gas from the reservoir tank then operates the limitorque, closing the main-line valve.

Since the adjustable orifice acts as a bypass around the differential element, it determines the proportion of the flow through the element from the



SHUTDOWN DEVICE developed by Transco works on principle of differential created across an oil-field-type choke nipple. Fig. 2.



SHUTDOWN DEVICE developed by Crose works on somewhat the same principle as that utilized in the Transco device. Fig. 3.

dome and reservoir tank. The adjustable orifice is set to require a 25 psi. per minute pipe-line pressure drop to activate the differential element and lift the daphragm valve off its seat.

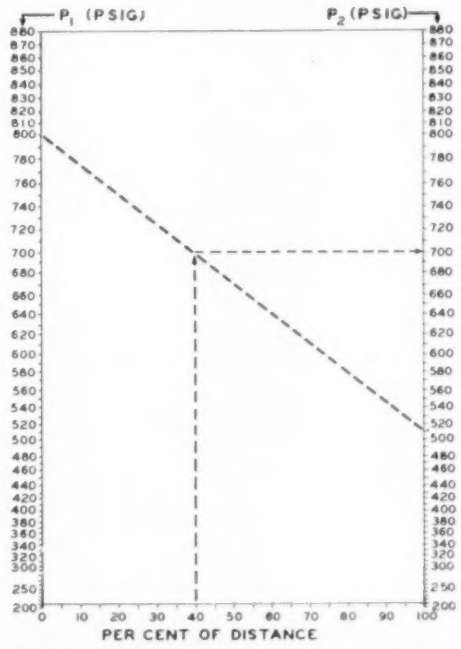
The check valve in the line from the reservoir tank traps the pressure in the dome when the differental element is closed, holding the diaphragm valve open. The check valve in the upper casing prevents backflow into the casing. A slight leak of gas through the differential element ball seat allows a delayed closing of the diaphragm valve after ample time has passed to insure closing of the main-line block valve. The pressure-rate drop settings for the shutdown devices were developed from an accumulation of both theoretical and actual line-failure data.

Pressure drop charts. From a theoretical standpoint Figs. 4, 5, and 6 were developed from the Panhandle formula and the following assumptions:

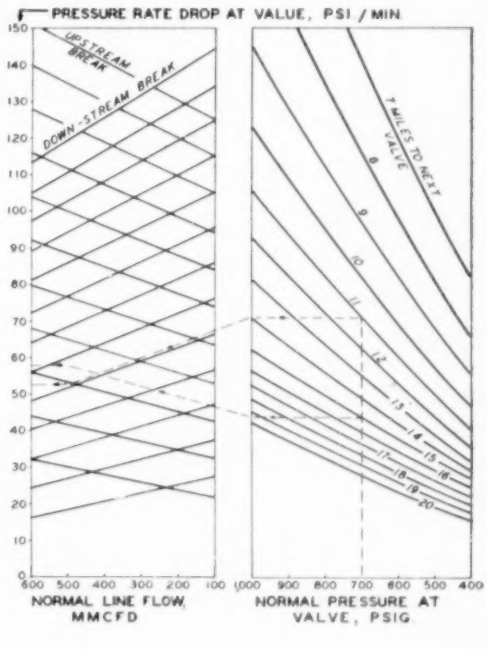
1. Flow temperature = 75° F.
2. Temperature base = 60° F.
3. Pressure base = 14.73 psia.
4. Gravity base = 0.60
5. Efficiency factor = 95

In order to use the charts, it is necessary to obtain the following data for each section between compressor stations.

1. The normal line flow (M.M.c.f.d.)
2. The valve spacing (miles)
3. The spacing between compressor stations (miles)
4. The nominal pipe diameter (inches)
5. The normal discharge pressure at the upstream compressor station (psia.)
6. The normal suction pressure at the downstream compressor station.



PRESSURE GRADIENT CHART for determining probable pressure at block valves in any gas pipe-line section. Example: P_1 = 800 psi.; P_2 = 510 psi. Find pressure at point located 40 per cent of distance between P_1 and P_2. Answer is seen to be 700 psi. Fig. 4.


PRESSURE RATE DROP AT VALVE, PSI / MIN
UPSTREAM BREAK
DOWN-STREAM BREAK
MILES TO NEXT VALVE
NORMAL LINE FLOW MMCFD
NORMAL PRESSURE AT VALVE, PSIG

PRESSURE-RATE DROP at valve in 30-in. o.d. natural gas pipe line for full line break various distances upstream or downstream from valve. Fig. 5.

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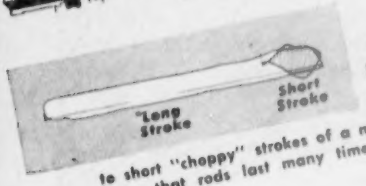

4 Dynagraph cards illustrate smooth, continuous and uniform loading on sucker rods compared to short "choppy" strokes of a mechanical unit. Field records show that rods last many times longer.

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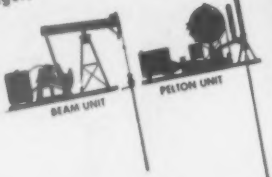

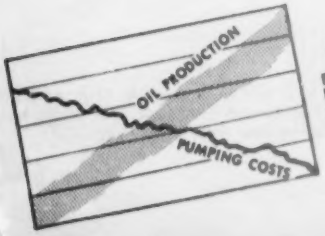

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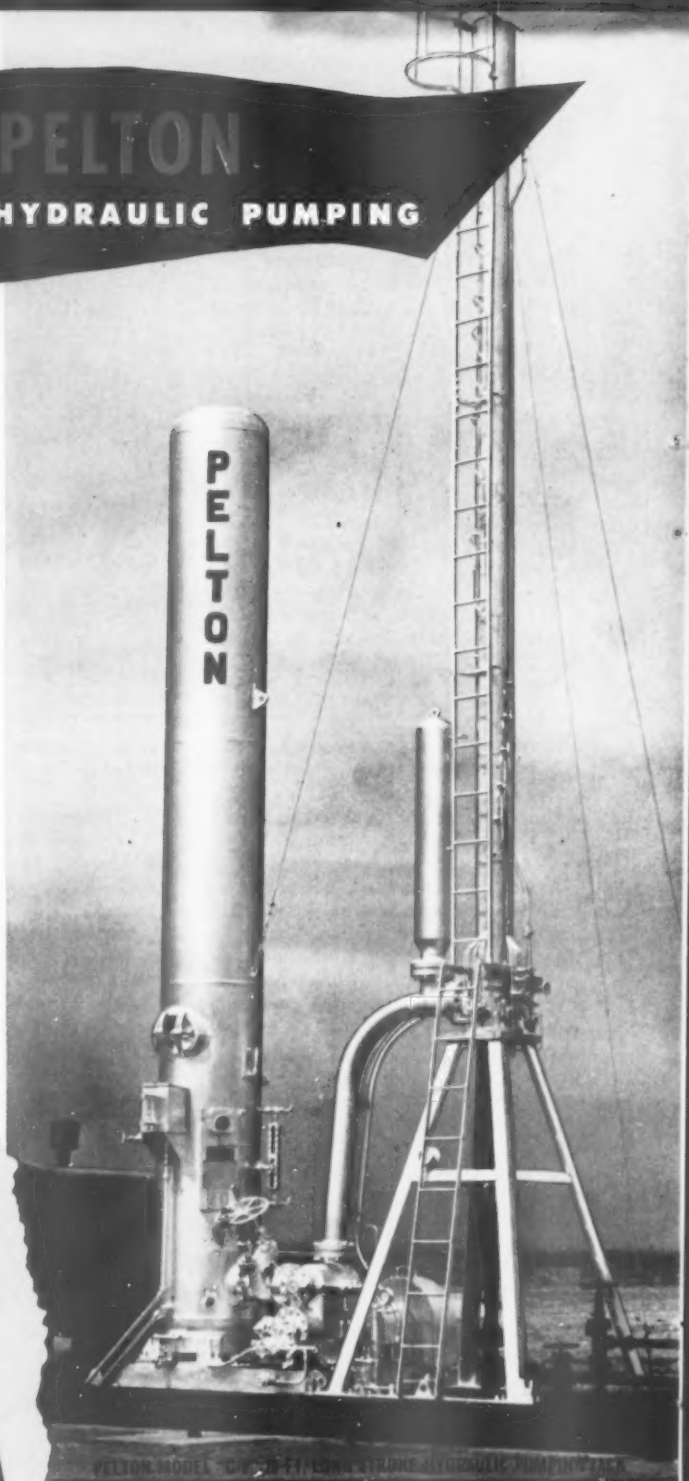

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Fig. 4. is used to determine the probable pressure at block valves in any gas pipe-line section. The line pressure at each end of the section must be known, as well as the length and location of the valve in the section.

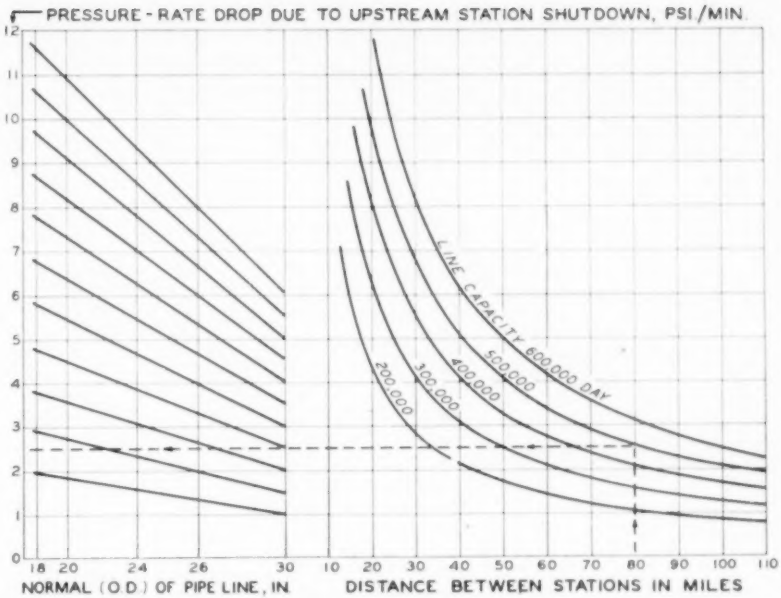
The pressure drop which would be caused by a full line break is covered by Fig. 5, which may be personalized for pipe lines of different sizes. The chart is entered with the normal line pressure at the valve as solved by Fig. 4. A vertical projection from this point forms an intersection with an appropriate valve spacing line on the chart. If the valves are unevenly spaced, two intersections should be made, one for the length of pipe line to the next valve upstream from the subject valve, and one similarly downstream. A line from each of these intersections is then projected horizontally to the left-hand border of the right-hand chart.

For line breaks downstream from the valve, the pressure-rate drop at the valve may then be found by extending a line to the left, parallel to the adjacent "downstream break" lines, to a point vertically above the normal line flow and thence horizontally to the pressure rate drop scale. For line breaks upstream from the valve, the pressure-rate drop at the valve may be found in a similar manner by use of the "upstream break" lines. Lesser of the two pressure-rate drop valves is important since it represents minimum pressure-rate drop at controlled valve, which would be caused by a full line break.

Fig. 6 concerns itself with the pressure-rate drop at any point in a section between compressor stations which would be caused by the shutdown of the upstream compressor station. The chart is entered at the approximate point on the right-hand section length scale. A horizonal projection from this point is carried to an intersection with the appropriate line-capacity curve and thence downward. An adjustment for pipe size is made by projecting from the intersection of the vertical line and the 30-in. reference line, parallel to the sloping line to the appropriate pipe-diameter line and thence downward to the bottom scale. This solves for the pressure rate drop due to an upstream station shutdown, which is the highest drop in normal operation.

The valve control should be set to operate on a pressure drop rate approximately halfway between the lowest emergency pressure drop rate (found on Fig. 5) and the highest normal pressure drop rate (found on Fig. 6). Barring mechanical defects, this will always insure valve closure under emergency conditions, but not under normal operating conditions.

As an example, consider a 30-in. o.d. pipe line of 500,000 M.c.f.d. capacity. With a block valve 40 per cent of the distance from an upstream compressor station of discharge pressure of 800 psig. 80 miles from a downstream compressor station with a suction pressure of 510 psig. The next adjacent controlled valves are 15 miles upstream and 11 miles downstream. What is the proper pressure-drop rate setting for this valve's automatic shutdown device? The initial projections necessary to de-



PRESSURE-RATE DROP for any point in a section between compressor stations, due to shutdown of the upstream compressor station. Fig. 6.

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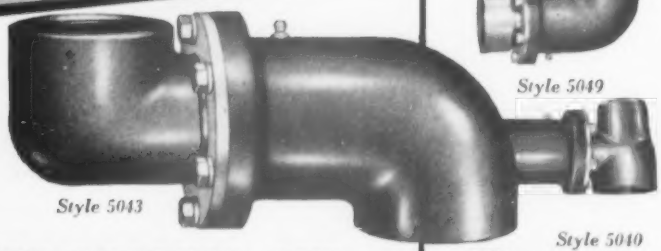

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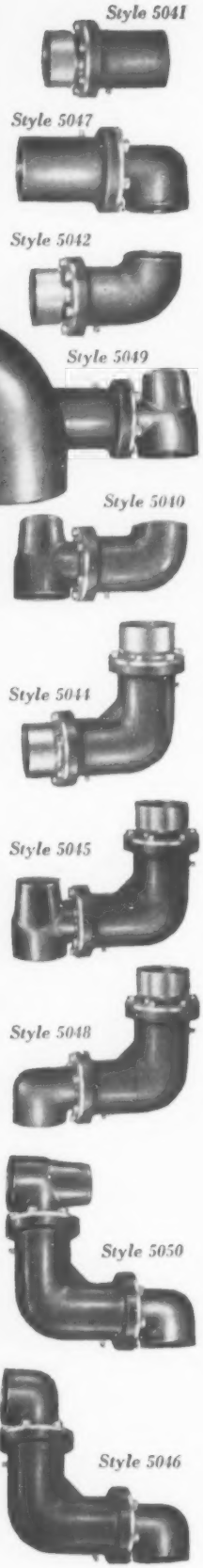


termine the normal pressure at the block valve are shown by the broken lines on Fig. 4.

Fig. 5 applies to 30-in. o.d. pipe at the 700-psig. point. A vertical projection from this point intersects the valve spacing curves at 15 miles and 11 miles. Horizontal projections to the left-hand margin of this chart are followed by slanting extensions parallel to the lines on the left hand chart. The extension of the "15-mile" intersection slants upward since this applies to the section upstream from the valve.

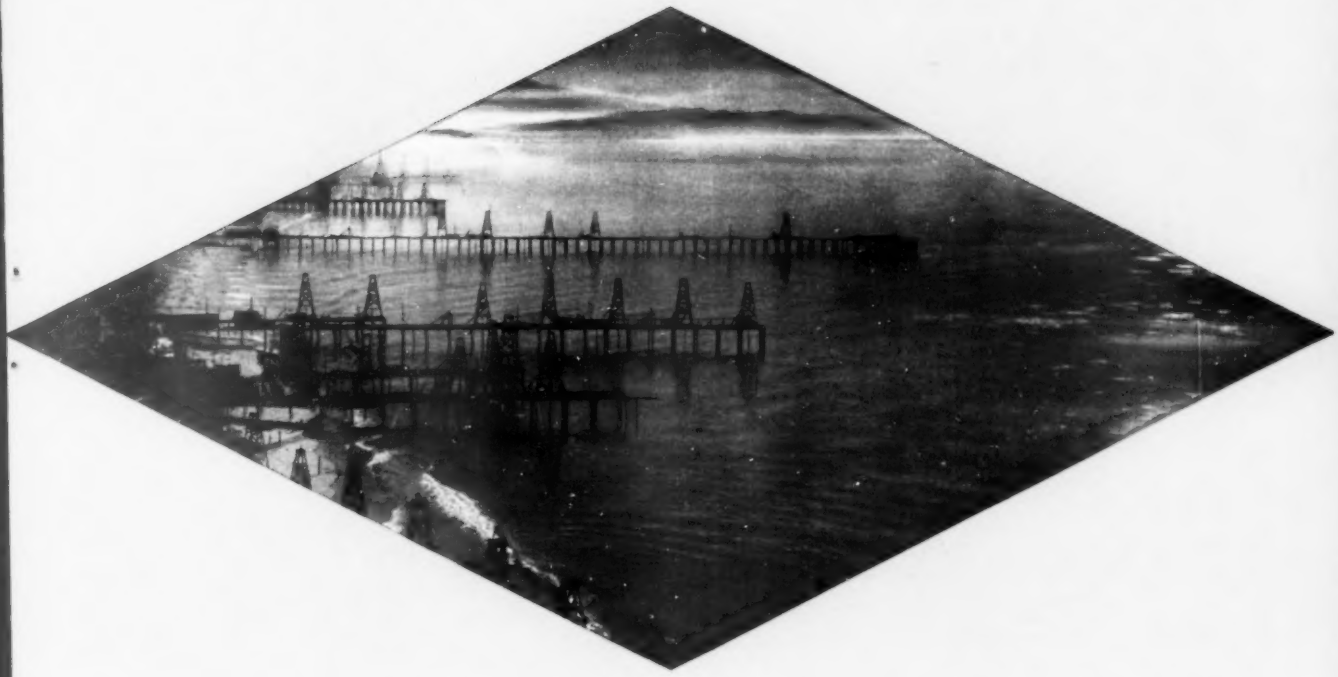
The extension of the "11-mile" intersection slants downward since it applies to the section downstream from the valve. Both extensions are projected horizontally to the left-hand scale after they cross the appropriate line flow ordinate, in this case 500 M.M.c.f.d. The minimum pressure-drop rate at the valve for a full line break is thus found to be 52.5 psi. per minute for downstream breaks and 58 psi. per minute for upstream breaks.

The pressure drop rate of 2.5 psi. per minute caused by an upstream station, for this example, is found by following the broken lines on Fig. 6. The shut-down-device setting lies between the minimum pressure drop rate due to a line break (52.5 psi. per minute) and the pressure drop rate due to a station shutdown (2.5 psi. per minute).

Multiple lines . . . Although Transcontinental at present has only one main line, it would seem plausible that valve controls working on the pressure-drop-rate principle are applicable to multiple lines. With certain adaptations this would be true for either multiple lines operated as isolated lines with crossover valves closed, or multiple lines operated together with crossover valves open.

Transcontinental's pressure-recording charts giving case histories of two failures during testing before operation and one river crossing failure during operation show that the theoretical charts are on the conservative side. This may be because the charts are based on the theory that gas flow from a broken line does not exceed acoustic velocity. Since considerably larger pressure rates were recorded on Transcontinental's pressure charts following line failures, there is reason to believe that the flow of gas from a broken line exceeds acoustic velocity.

Therefore, it can safely be said that a major pipe-line failure is distinctive; normal operations are not to be compared with it. Since the automatic controls are not intended to detect or respond to minor leaks or operation changes control units have been standardized to require a 25-psi. per minute pressure drop.



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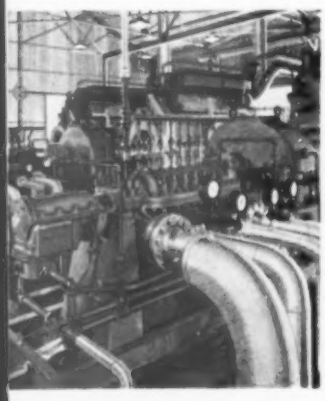

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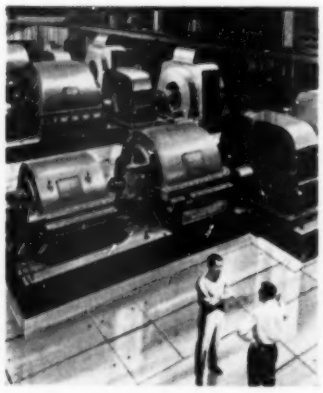

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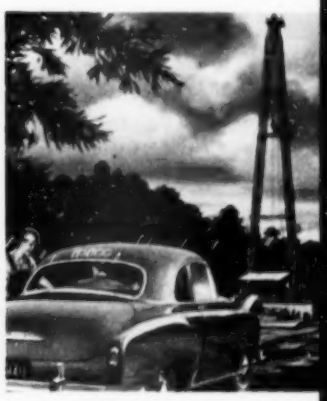

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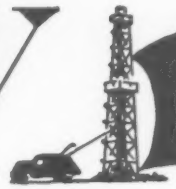

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1. Producing well loses all production. No production even after perforating by other make of jet perforator.	Improved McCullough 2¼" Sectional Burrless Bullet Perforator. Twenty holes shot through the 4½" cemented upset tubing at about 6800 feet. Time one hour and 45 minutes.	**0 B/D to 70 B/D**
2. New Well. Very hard chalk formation. Always had to be acidized to make production. Two strings cemented casing —5½" and 7".	Improved McCullough Super Formation Glass Jet Perforator and Steel Strip Carrier. Twenty-five holes shot at about 2100 feet. Time—one hour.	**0 B/D to 50 B/D** More production than usual from this formation and without acidizing.
3. Had been perforated with other make perforator, swabbed dry without recovering any oil.	Improved McCullough Standard Glass Jet Perforator and Steel Strip Carrier. Thirty holes shot through 5½", 15½# cemented casing at about 5700 feet. Time—one hour and thirty minutes.	**0 B/D to 360 B/D** Best well in field.
4. Well had been shot by other make jet perforator without results.	Improved McCullough 3½" M-3 Burrless Bullet Perforator shot 260 ½" holes at about 10,000 feet. Time—seven hours.	Well surfaced and started flowing in five hours. Production not given.
5. Company engineer wanted well perforated fastest way.	New McCullough Super Casing Glass Jet Perforator with a 50 foot Steel Strip Carrier.	Two hundred holes shot simultaneously in one hour and five minutes—a savings of four hours rig time.
6. New Well. Operator expected top production of 500 B/D.	Improved McCullough 4¼" M-3 Burrless Bullet Perforator. Eight hundred seventy holes shot through 7" cemented casing at about 6000 feet in thirteen hours.	**0 B/D to 1000 B/D** A mighty fine well!!!

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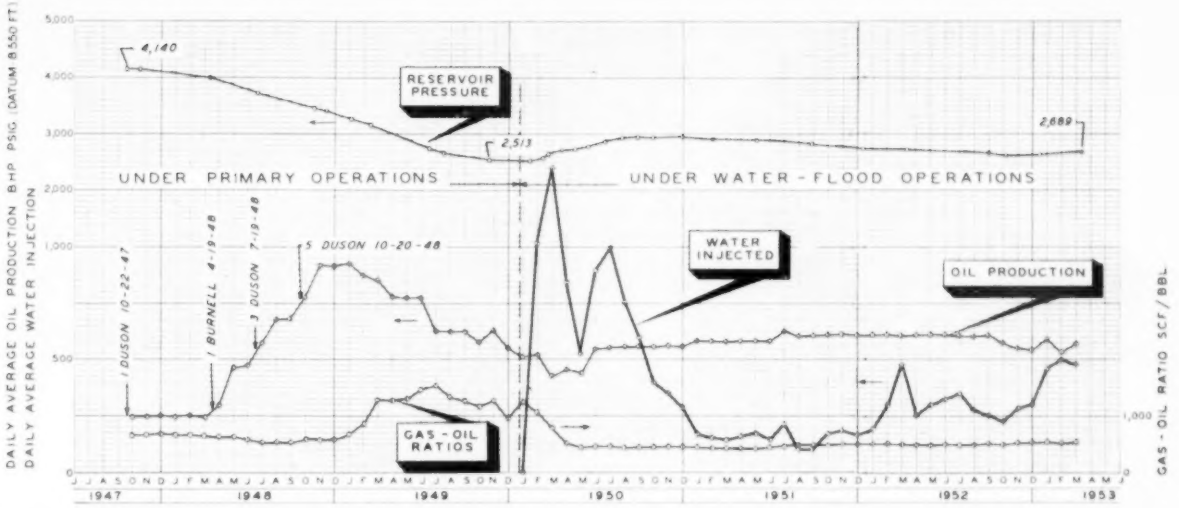


HIGH OIL RATES accompanied by low gas-oil ratios and satisfactory pressure restoration were made possible through water injection since January 1950 which augmented deficient reservoir energy in the W-2 fault segment at Iota, Louisiana, oil field.

GULF COAST WATER INJECTION

Flooding a Small Fault Segment . . .

. . . *in a deep-seated salt-dome field*

Pressure maintenance will recover an additional 2,000,000 bbl. of oil from an area of 200 acres

by Joseph A. Kornfeld
District Editor

PRESSURE maintenance by water flooding is expected to result in gains of 2,000,000 bbl. of oil over recoveries expected by primary operations, from a 200-acre fault segment in Iota field, Acadia Parish, Louisiana.

This project, now 3½ years old, demonstrates the feasibility of water flooding of fault segments of small areas overlying deep-seated salt-dome structures in the Gulf Coast region. Additional recovery by flooding is expected to bring a long-term gain of $5,000,000 to Crown Central Petroleum Corp. and the royalty owners.

Practical benefits to be obtained from water injection in this fault block include:

- Additional recovery of 2,000,000 bbl. of oil.
- Sustaining of oil rates at 200 bbl. per day per well without damaging the reservoir.
- Correction of reservoir damage brought about by high oil withdrawals under a deficiency in reservoir energy. (The particular fault segment flooded exhibited a partial water drive.)

Subsurface Geology

Iota field is a deep-seated salt-dome structure. A major 550-ft. fault, trending north-south, divides the field into east and west halves. The western half of the field is in turn divided into four fault segments. Each segment forms separate fault blocks bounded by faults with displacements of from 100 to 300 ft.

Radial arrangement of these fault blocks, generally characteristic of deep-seated Gulf Coast structures, is shown in Fig. 1. Water is being injected into the Duson sand reservoir in fault block W-2.

Duson sand reservoir . . . This reservoir lies at subsea depths of about 8,600 to 8,804 ft. in this W-2 fault block, comprising an oil column of about 200 ft. The original oil-water contact was 8,804 ft. subsea. Within this fault block, four oil wells were drilled and completed during 1947 and 1948 as follows:

Crown Central 1 Duson, completed October 22, 1947.

Crown Central 1 Burnell, completed April 19, 1948.

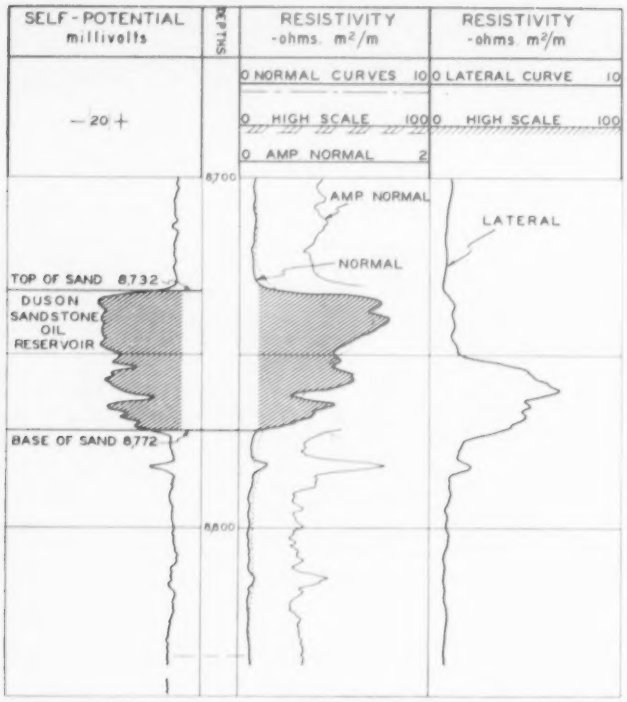
Crown Central 3 Duson, completed July 19, 1948.

Crown Central 5 Duson, completed October 20, 1948.

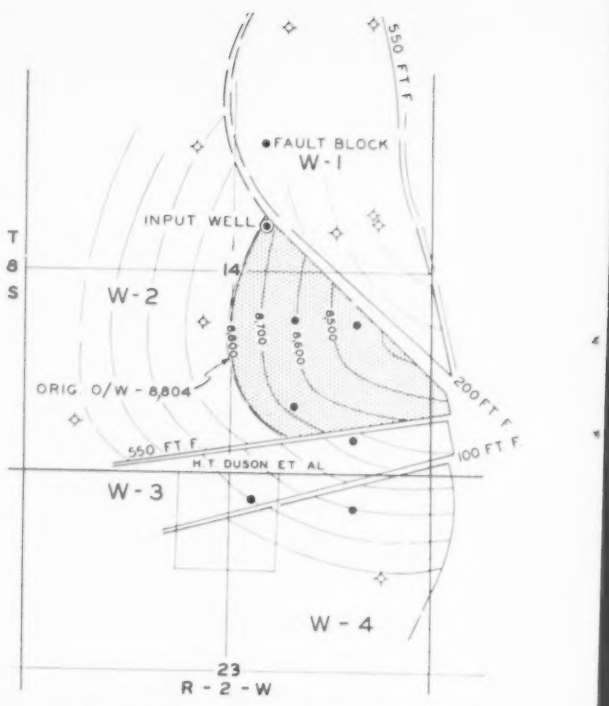
Production History

Although the oil wells completed from the Duson sand in the W-2 fault block exhibited a high productive capacity, the reservoir energy was insufficient to maintain the high oil rates of from 175 to 225 bbl. per well per day at which they were produced during the fall of 1948 and the spring of 1949.

Initial observed reservoir pressure of the Duson sand was 4,140 psig., measured at datum of —8,770 ft. When the fault block was drilled up by October 20, 1948, daily oil rates in effect at that time totaled 780 bbl. per day, or 195 bbl. per well from four wells. Crude-oil withdrawals from the fault segment rose to a peak of 912 bbl.



DUSON SAND DEVELOPMENT in the dW-2 fault segment at Iota is typified by this electric log of pay section of Crown Central Petroleum Corp. 3 Duson, 882 ft. east and 666 ft. south of center of 14-8s-2w. Mud resistivity: 2.4 m.²/m. at 84° F. Electrode spacings: AM = 16-in.; AM' = 64-in.; and OA = 18⅔-ft. Bit size is 9⅞-in.



SUBSURFACE STRUCTURE CONTOUR MAP of the west part of Iota field showing various fault segments created by displacements ranging from 100 to 550 ft. Under water injection since January 1950 is fault block W-2. Structural contours are prepared on top of the Duson oil sand.

daily; this was a daily average of 228 bbl. per well.

The reservoir was unable to sustain these high withdrawal rates and production declined to a daily average of 429 bbl. for the fault block by March 1950. Meanwhile, reservoir pressure dropped sharply from 3,467 psig. at datum of —8,770 ft. (corresponding to the highest oil rate of 920 bbl. in November 1948) to 2,513 psig. on November 22, 1949; this was a pressure drop of 954 psig. in a period of only a year, or a slump of 80 psig. per month.

Produced gas-oil ratios rose sharply during this period from 570 cu. ft. per bbl. (about the solution ratio) as of November 1948 which was the oil-rate peak, to over 1,500 cu. ft. per bbl. by August 1, 1949.

Water Injection Initiated

Observing the sharp declines in oil rates and reservoir pressures accompanied by a sharp rise in produced gas-oil ratios, Crown Central officials asked the Department of Conservation of the State of Louisiana for permission to inject water into the Duson sand oil reservoir, W-2 fault segment. At the hearing held on December 15, 1949, the request covered an experimental period of 6 months.

The Department of Conservation issued an order on January 25, 1950, granting Crown Central permission to commence its water-injection program at Iota. Almost immediately on issuance of the order water was introduced into the sand. Nearly a year later, on January 1, 1951, the Department of Conservation in its Order 181, effective as of that date, made this a permanent project.

Since very little water is produced with oil from wells completed in the Duson reservoir in the W-2 fault block, the first problem was to obtain an adequate makeup-water supply. Originally, all water for injection was obtained from a supply well. This well was converted from an old dry hole in which 3,000 ft. of surface casing remained. In working over this well pipe was underreamed and a Miocene water-bearing sandstone lying slightly below 3,000 ft. was gravel packed.

Water was produced by installation of a simple gas-lift system into the well; this consisted of 200 ft. of tubing and three fixed jets. Gas supply to operate the system was obtained from waste flare gas obtained from a low-pressure separator. A simple pilot valve borrowed from a treater, and actuated by the float in an accumulator tank, controlled the jet gas automatically as required by the injection system.

Closed system . . . A closed system was maintained by means of a gas blanket kept on the accumulator tank. During the first 2 years of operation of the flood, injection water was not filtered. However, during 1952 a considerable increase in produced water from wells located in other fault blocks at Iota made filtering of produced water advisable. Accordingly, a sand filter was installed. Other than air exclusion, treatment of water has not been found necessary to this date.

Originally the project was equipped with a high-pressure pump; pressure was required when pumping into the injection well at rates of about 1,000 bbl. per day. However, the injection well was given an acid treatment early in 1950 which improved its injectivity. Moreover, a reduction in injection rate has allowed most of the water to be introduced without the application of surface pressure. After this well was given a second acid treatment in the summer of 1952, it took injection water under vacuum.

Injection well . . . An oil well situated near the oil-water contact on the west side of the W-2 fault segment in the Duson reservoir was selected for injection. At the time of conversion in January 1950, this well, 1 Duson, was

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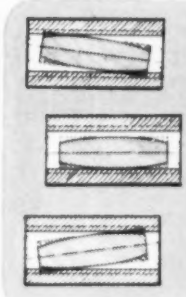

Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear tooth of conventional gear-type coupling.)

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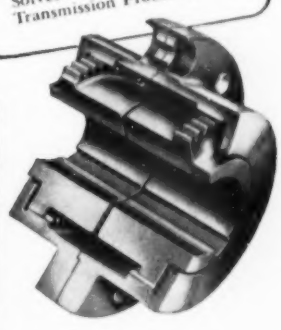

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making small amounts of oil at high water-oil ratios. To convert to injection, workover crews pulled tubing and ran gun perforator opposite the remainder of the entire section of the Duson sand. After gun perforations were made, the well was cleaned with mud acid and water lines laid from the supply well for starting injection. Tubing was rerun into the well without a packer.

Initially, water-injection rates into this well were high, averaging 1,425 bbl. per day. However, since the reservoir's response to water injection proved favorable, operators sharply lowered injection rates to 525 bbl. daily by May 1950. Except for a temporarily high rate of from 950 to 1,000 bbl. per day during June and July 1950, injection rates have been lowered progressively. At this writing, these rates average only about 350 bbl. per day.

Response of the Duson sand reservoir to water injection was rapid. Within a period of only 6 months from the inception of the project, gas-oil ratio of the high-ratio well (1 Burnell) at the crest of the structure dropped to a figure near the original solution ratio. Reservoir pressures had been restored nearly 300 psi. in the half year mentioned. This marked improvement in reservoir behavior from this fault segment permitted operators to increase oil-withdrawal rates from 425 bbl. daily on April 1, 1950, to 550 bbl. daily on August 1, 1950.

Pressure Restored

Reservoir pressure had declined to a low of 2,513 psig. on November 22, 1949. Voluntary reduction in oil rates to 425 bbl. per day caused a buildup of 39 psi. by February 10, 1950, shortly after commencement of water injection. But by August 1, 1950, pressures increased to 2,860 psig., a gain of 308 psi. due to pressure maintenance alone. Pressure continued to rise and reached a new peak of 2,924 psi. by November 1, 1950.

During 1951 and 1952, oil withdrawals averaged around 600 bbl. per day; this was 200 bbl. per well per day for three wells. Under this sustained high oil rate, reservoir pressures dropped only 8 psi. per month for the first half of 1951, as compared to 80 psi. per month before water injection.

Toward the end of 1950, it was discovered that injection was affecting the adjoining small reservoirs in the west sector. Therefore, it was decided that pressure in the W-2 fault block should be reduced to an optimum value in the general region of 2,650 psig. Accordingly, during the next 2 years, injection rates were maintained at lower figures, and pressures were allowed to decrease in the W-2 fault block. By April 1, 1953, it appeared that injection of 350 bbl. per day would approximately maintain reservoir pressure, with an oil withdrawal of 565 bbl. per day from the three producing wells.

This injection is insufficient by itself to balance the withdrawal of 565 bbl. of stock-tank oil daily; material-balance calculations proved that a limited natural water drive contributed the remainder of reservoir energy.

Present Reservoir Behavior

Reservoir conditions as of April 1, 1953, were highly satisfactory. Oil rates were sustained at 565 bbl. for the entire reservoir and the response to this withdrawal rate was favorable with a water injection rate of 350 bbl. per day. As a consequence:

- The Duson sand is being produced at a rate which does not harm the reservoir.
- Produced gas-oil ratios remain at nearly original conditions of 500 cu. ft. per barrel.
- Reservoir pressure has leveled off and is being maintained currently at pressures of from 2,600 to 2,700 psig.

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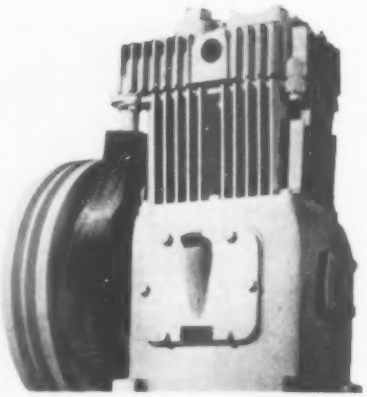

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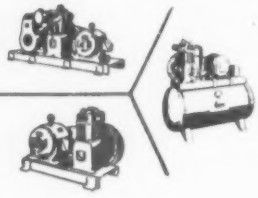

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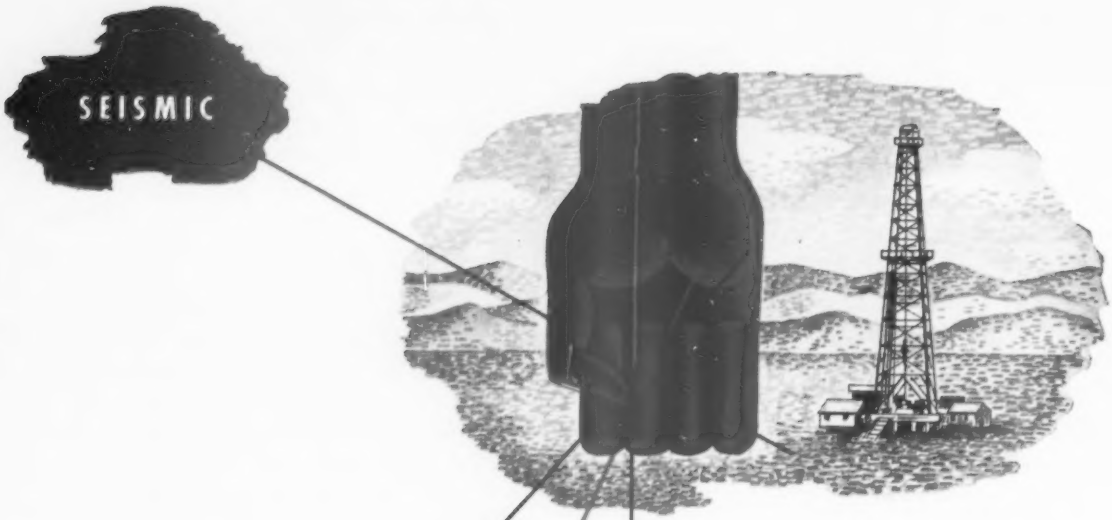

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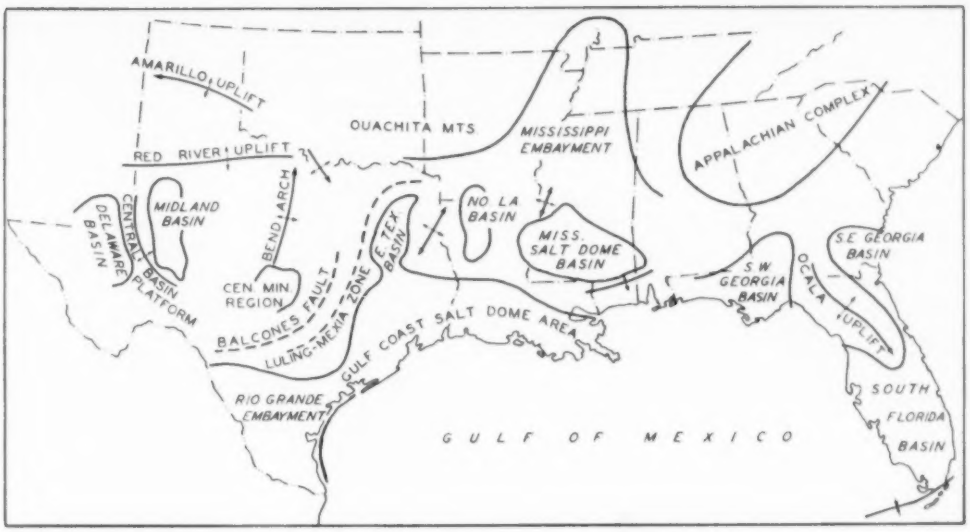


Fig. 1—Sketch map showing geologic features of the Gulf Coast states.

Here's a roundup of some current views on

GEOLOGY OF THE GULF COAST*

AS a geologic province, the Gulf Coast extends around the Gulf of Mexico from Florida to northern Mexico. In this article, however, the term "Gulf Coast" is used as in common oil parlance and limited to that portion between the Rio Grande and the Mississippi delta; i.e., the southern parts of Texas and Louisiana, with the adjoining shallow waters of the gulf. It extends for approximately 700 miles in a curving line around the coast: 250 miles of this is in Louisiana, the remainder in Texas. The width of this band is roughly 140 miles. Beginning where the Sabine uplift bends at the northern margin of the eastern counties of Texas, the land portion of the belt is somewhat narrower to the east. This narrowing, however, is balanced by the greater width of shoal water offshore (see Fig. 1).

Gently rolling country, representing in large part remnants of Pleistocene terraces, extends to within about 50 miles of the coast. At this point, which is marked in places by a traceable escarpment like the Hockley scrap north of Houston, it gives way to the coastal plain. The prairie, marsh, and swamp of the coastal plain slope very gradually to sea level. They are broken by bays, lakes, and bayous. Aside from the low, long mounds of distributaries and natural levees of the bayous, the only elevations are sand dunes and the striking mounds found occasionally over shallow salt domes.

Beds of Mesozoic age and their included or underlying salt have been omitted from this discussion. The Cretaceous has been drilled and produced only along the very north margin of the Gulf Coast. Knowledge of these older sediments is derived almost entirely from adjoining regions.

Cenozoic Sediments

The clay, sands, and shales of the entire Cenozoic have a similar origin. Southward flowing rivers, comparable with those of today, brought great volumes of sediments from the same general area around the interior of the continent. The sediments were deposited on flood plains crossing coastal plains, massed in dunes and bars near the beaches, and spread over the floor of the gulf throughout the entire era. Periods of regressive seas with growth and seaward extension of the land area alternated with shorter periods of transgression when the sinking and tilting of the land brought marine deposits over earlier continental sediments. Sediments deposited during different phases of the regressions and transgressions vary in lithology and in their faunal content. Commonly, tongues of marine shale containing relatively deep water faunas thin updip where they grade into sands deposited in near-shore and continental environments. In general, these transition zones from marine to continental sediments migrate seaward in successively younger formational units up to the Pleistocene.

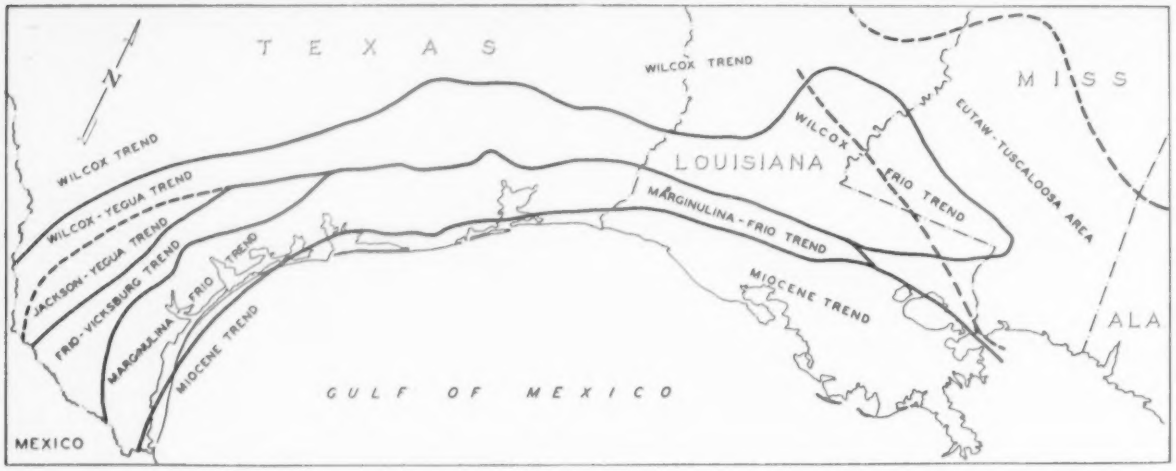
Reservoir sands . . . This seaward migration of the transition zones has determined the positions of productive trends or "fairways" which are located slightly seaward of the transition zone in each formational unit. Favorable conditions for accumulation of oil and gas along those productive trends are due partly to the mutual proximity of source and reservoir rocks. Sands suitable for reservoirs are rare to absent farther downdip where the sediments consist chiefly of shale, and source beds for oil are rare farther updip in the predominantly continental assemblage of sediments.

The productive trends for individual stratigraphic units have been delineated on the map on Gulf Coast production trends (Fig. 2). These trends overlap to some extent—thus production from different formational units is fairly common in fields located along the boundaries of the productive trends.

Formational units thicken as they are traced in the subsurface from their updip, continental facies to their downdip, marine facies. The rate of thickening, which is fairly constant for in-

* Prepared by the field trip committee of the joint annual meeting of the A.A.P.G., S.E.P.M., and S.E.G., Houston, March 1953, for the convention's guide book. Committee chairman, William A. Thomas, Ohio Oil Co.; editor, Duncan A. McNaughton, Gulf Oil Corp.

MAJOR PRODUCING TRENDS OF THE GULF COAST. Fig. 2



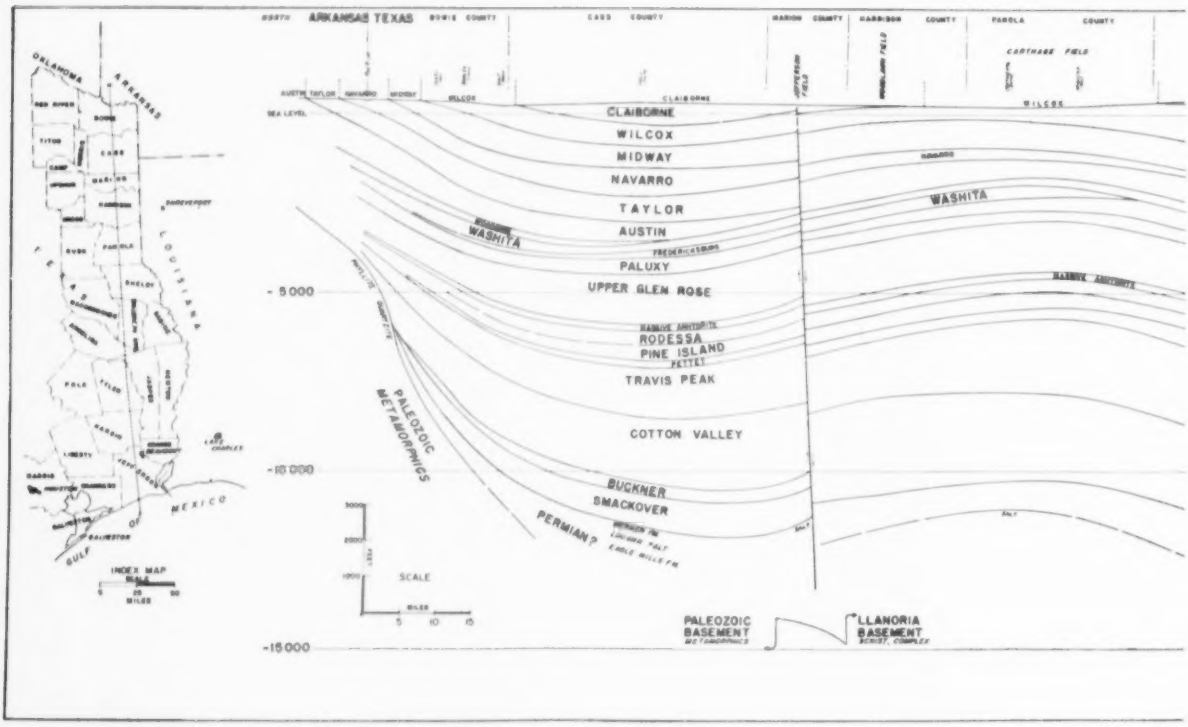
dividual stratigraphic units in their continental and near-shore, marine facies, increases rapidly in their deeper, marine facies. Seaward dips also steepen as the rate of thickening increases, thus forming a flexure that is often aptly described as a "hinge line." These structures, like the closely associated transition zones between marine and continental facies, migrate seaward in successively younger formations.

Various views are held on the origin of the hinge lines. Some geologists, impressed by the similarities between these structures and breaks in slope at the margins of continental shelves, consider them to be buried margins of ancient shelves. Others, impressed by the changes from sand to shale facies along the hinge lines and by changes in rates of thickening at the hinges, believe that the structures resulted from differential compaction in sediments and differential subsidence in response to excess loading seaward of the hinge. Still other geologists, impressed by the close, spatial association of hinge lines and regional seaward-dipping gravity faults suggest that the hinge may have originated as the result of movement along these faults. The various views are not mutually exclusive and probably they will all be incorporated in the final story of the origin of these interesting structures.

Stratigraphy

The Cenozoic column, marine or nonmarine, contains little other than

NORTH TO SOUTH GULF COAST CROSS-SECTION THROUGH



sand, clay, and shale. Some lignite is found in the continental portions, particularly of the Eocene. Thin lenses of bentonitic ash seem associated, in part at least, with the vulcanism that formed the anomalous serpentine oil fields in front of the Balcones fault zone along the northern edge of the area in Southwest Texas. Limestones are almost entirely missing. On parts of some salt domes, in that portion of the Oligocene (Anahuac) marked by the foraminifera Heterostegina, isolated lenses of reef limestone are found. A thick reef of the same age is developed east of the Mississippi River under southern Lake Pontchartrain where it is not associated with known salt domes.

Correlation problems . . . A definite description of a stratigraphic column will not apply to all of the Gulf Coast. Through a long period and over a wide expanse, the flood plains and deltas of several rivers may merge to give a certain uniformity. At other times, the variations in amount and type of sediments that different portions received from their local sources have resulted in marked changes in the stratigraphy. Although the major transgressions were effective on a sufficiently uniform scale that they are readily recognized throughout the region, there were also local basins created by differential subsidence. These restricted embayments were filled with thick deposits that are missing, but without recognized hiatus, elsewhere. Changes in thickness and character of sedimentary units are encountered on many structures, particularly where sediments are pierced by salt. These changes are due to several factors including the following: (1) uneven bottom topography during deposition, (2) faulting concurrent with deposition, and (3) flowage of shale along contacts between domal material and sediments. Their role in localizing accumulations on structures is becoming apparent as correlations become more reliable.

The maximum thickness of all stratigraphic units of the Cenozoic cannot be accurately determined. An arbitrary thickness of 30,000 ft. is sometimes adopted as a working figure; but this seems overly conservative, especially in southern Louisiana where wells will be drilled to 20,000 ft. without reaching the middle of the Miocene.

Regional Structure

The arcuate homocline forming the northern limb of the Gulf of Mexico geosyncline is the major structure in the Gulf Coast. Seaward dips on this structure are the sum of original seaward slopes of surfaces on which sediments were deposited, plus crustal subsidence during development of the geosynclinal trough, plus the effects of differential compaction in sands and muds. Seaward dips steepen along hinge lines that migrate seaward in successively younger formational units (see Figs. 2 and 3).

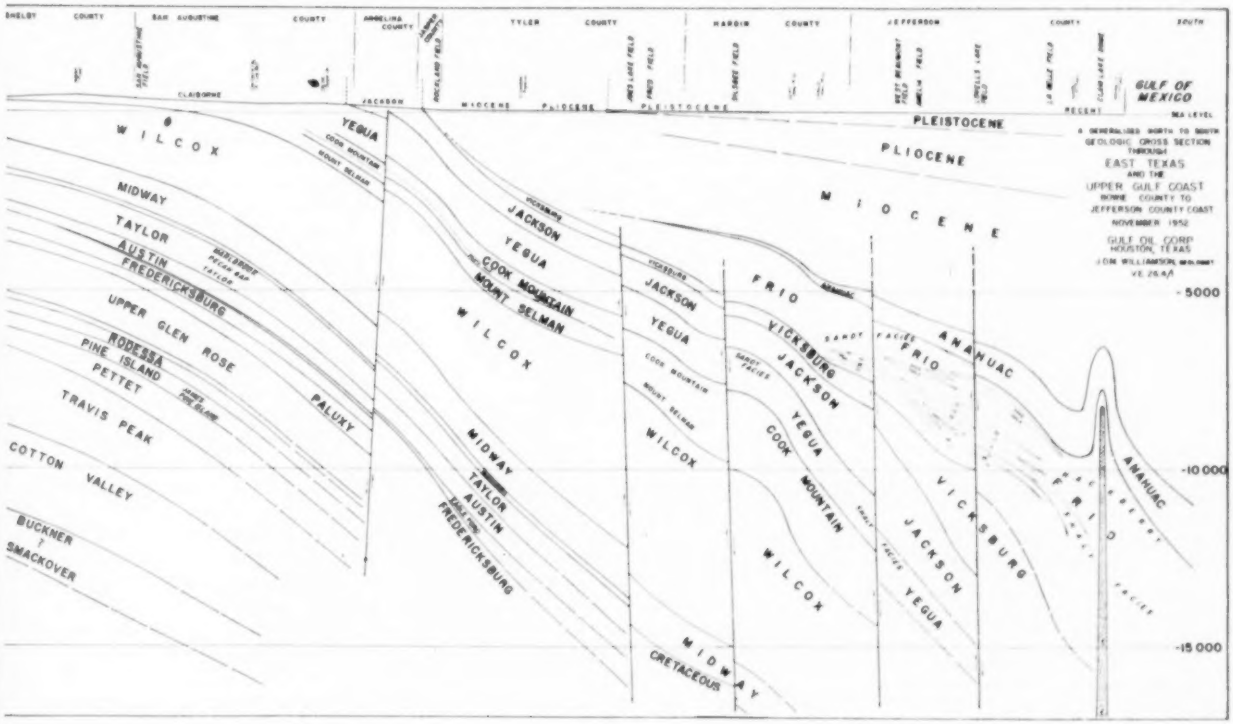
The homocline is interrupted by the Mississippi, East Texas, and Rio Grande transverse embayments created by crustal downwarping in these areas.

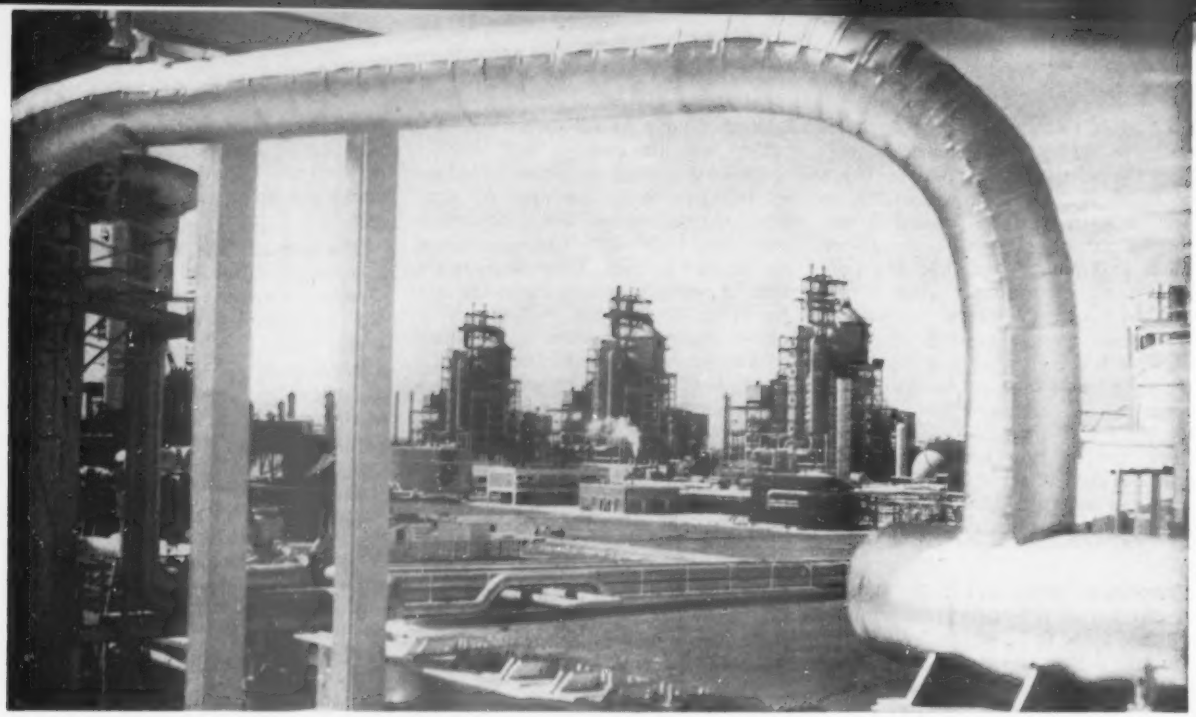
Numerous gravity faults, some of which are traceable for over 100 miles in the subsurface, interrupt the homoclinal structure. Their trends are generally parallel to the present coast line; they dip seaward at angles ranging from 40° to 60°; stratigraphic throws up to 3,000 ft. have been reported; displacements increase with depth, and stratigraphic units are thicker on the downthrown block than they are on the upthrown, thus indicating that the faults were active during deposition.

Anticlinal folds are closely associated spatially with these regional faults. They are located on the downthrown block; and their axes are generally parallel to the trend of the fault. They are anomalous features to the extent that the "dip into the fault" cannot be attributed to drag which would have simply increased seaward dips on both sides of the fault. Various views are held on the origin of the anticlines. Some geologists believe that the folds

(Continued on page 274)

EAST TEXAS (BOWIE COUNTY TO GULF OF MEXICO). Fig. 3





Cities Service Refining Corp.'s three F.C.C. units. The propane deasphalting unit may be seen in front of the cat crackers. This unit is used to deasphalt all reduced crude in preparing gas oil for "A" catalytic cracking unit at the left. The center "B" cat cracker is fed virgin heavy gas oil and the "C" unit on the right uses heavy cycle oil and virgin light gas oil as feed.

BETTER CAUSTIC UTILIZATION

. . . within a modern refinery treating plant

by Austin V. Sierra*

Advantages: Several operating and chemical savings, plus revenue which could be used to help defray chemical costs

THE Cities Service Refining Corp. utilizes over a million pounds of 100 per cent caustic (sodium hydroxide) per month at its Lake Charles, La., refinery. The majority of this caustic is used at the treating plant, which is a central unit for processing most of the refinery products which require specialized treatment.

Despite increased crude runs and subsequent increased product-treating requirements, the use of caustic has been held to a minimum through careful planning and secondary utilization.

The refinery treating plant consists of six major units which require caustic in their operations. The following is a description of these units, their functions and their relative position in the over-all refinery caustic-utilization schemes.

Unisol unit . . . This is a unit provided for the purpose of extracting mercaptans and other organic sulfur compounds from virgin gasoline base stocks. It has been determined by a series of scientific investigators that mercaptans and other allied sulfur compounds found in crude oils are very detrimental to the octane-number improvement produced by the addition of tetraethyl lead.

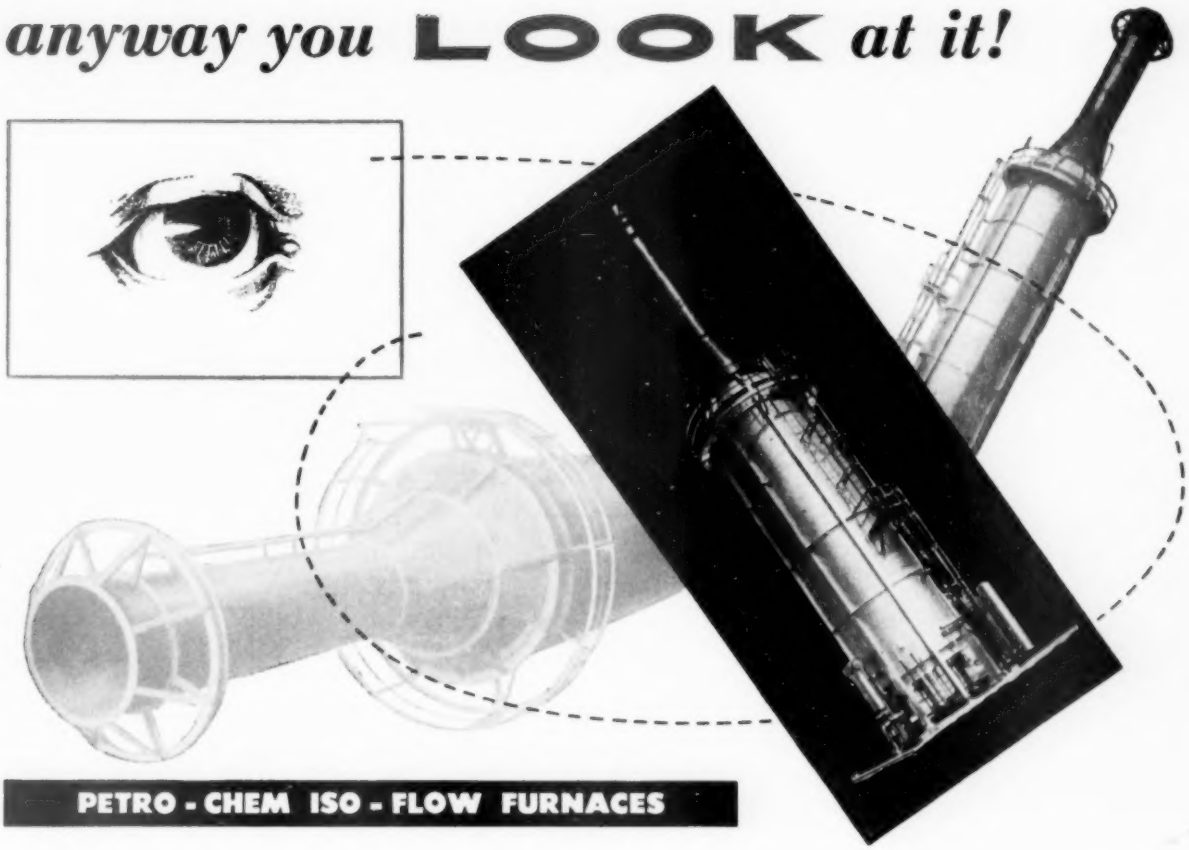
In the Unisol process, the gasoline stream is contacted countercurrently with a mixture of 47° B. caustic and 95 per cent methyl alcohol in an extraction tower. The caustic methyl alcohol mixture containing the extracted mercaptans is separated into a methyl alcohol-mercaptan mixture and 47° B. caustic in a stripping tower. The regenerated caustic is recirculated back to the extraction tower and a portion is pumped away to other units in the treating plant. This stream is called the Unisol caustic purge stream. The Unisol unit is charged directly with fresh 50° B. caustic as makeup. The caustic is diluted to 47° B. within the process. A typical Unisol unit flow sheet is shown in Fig. 1.

The mercaptan-methyl alcohol mixture is separated into its components, the methyl alcohol is recirculated to the extraction tower, and the mercaptan stream is discarded. Process studies have shown that by using the caustic makeup system, a caustic containing relatively few impurities can be maintained in the unit. This results in mercaptan-extraction efficiencies in excess of 90 per cent with a resultant increase of from two to five octane numbers on the leaded gasoline. In addition, the treated gasoline exhibits exceptionally low A.S.T.M. and copper-dish gums together with excellent copper strip corrosion tests.

Regenerative caustic unit . . . This unit is used to extract mercaptans and allied compounds from gasoline base stocks produced from catalytic cracking, thermal reforming, and thermal cracking operations. The virgin butane and pentane streams are also treated in this unit. Extraction is accomplished by the countercurrent contacting of the hydrocarbon streams in extraction towers with a stream of 20° B. caustic. The caustic mercaptan mixture is routed to a steam stripper where the mercaptans are stripped from the caus-

* Senior process engineer affiliated with the acid and treating department, Cities Service Refining Corp. Sierra graduated from Tulane University in 1944 with a B.E. degree in chemical engineering. He was associated with E. I. Du Pont and Celotex Corp. before joining Cities Service in 1946.

anyway you LOOK *at it!*



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tic, condensed, and discarded. The regenerated caustic is cooled and recycled back to the mercaptan extractors.

The nature of the gasoline streams being treated in this unit is such that a buildup of the sodium salts of organic acids such as phenols, cresols, etc., occurs and the caustic must be discarded periodically. A portion of this discarded caustic is utilized to remove these acid oils from the higher-boiling catalytic gasoline streams. Refinery experience has shown that if these acid oils sometimes called natural inhibitors are completely removed from the gasoline streams, excellent gasoline gum-inhibitor response occurs. In this unit, final sweetening of the gasoline streams is accomplished through the use of gasoline gum inhibitor.

When the caustic stream used for removing acid oils builds up to an accumulation of 40 per cent by volume acid oils, the stream is dumped to storage. When sufficient quantities of this stream are accumulated, the caustic is loaded into tank cars and sold to firms which process the caustic to obtain the acid oils. The sales price of the caustic is determined by its acid oil content.

A portion of this acid oil caustic is pumped to the alkylation units where it is used for corrosion inhibition and pH control in the fractionating towers.

A portion of the Unisol unit caustic purge stream is utilized as makeup to the regenerative unit. The 47° B. caustic is diluted with water to 20° B. as it is added to the regenerative unit.

Blend oil unit . . . Another unit which utilized the Unisol purge caustic as its caustic charge is the blend oil unit. In this unit, a hydrocarbon stream similar to kerosine produced from sour crudes is treated with alkylation sludge acid to effect partial desulfurization of the oil. The treated oil is used as blending stock for light cycle oil produced from the catalytic cracking units in the compounding of No. 2 furnace oil.

After the acid treatment, the oil is neutralized with Unisol purge caustic which has been diluted with water to approximately 10° B. The spent caustic from this unit is discarded. The product from the blend oil unit is a neutral oil which has had 40 per cent of its original total sulfur content removed. Refinery experience has shown that the use of this oil in blending No. 2 furnace oil results in an oil having improved color and sludge stability.

Prewash system . . . The final unit which utilizes Unisol purge caustic as its source of caustic is the prewash system. All of the gasoline feed streams to the Unisol and regenerative caustic units must be free of hydrogen sulfide.

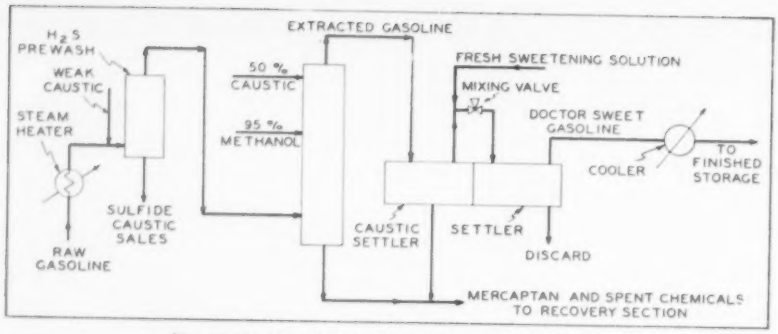


Fig. 1—Typical Unisol mercaptan extraction unit.

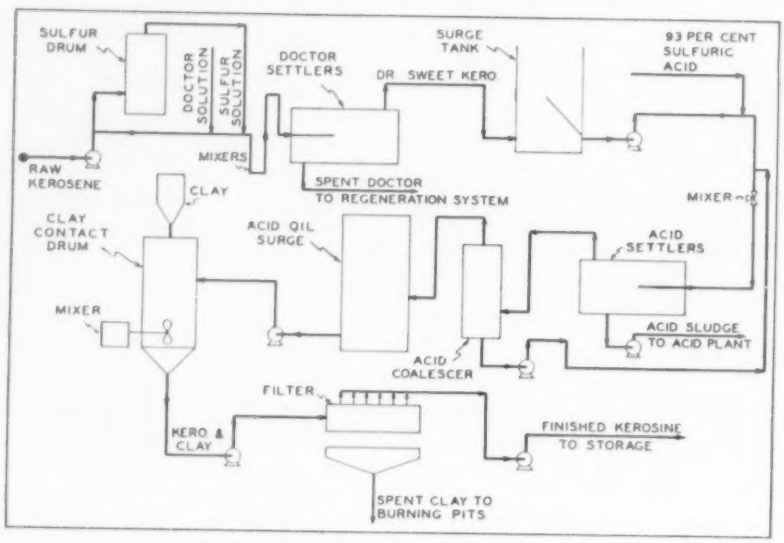


Fig. 2—Simplified flow diagram of kerosine unit.

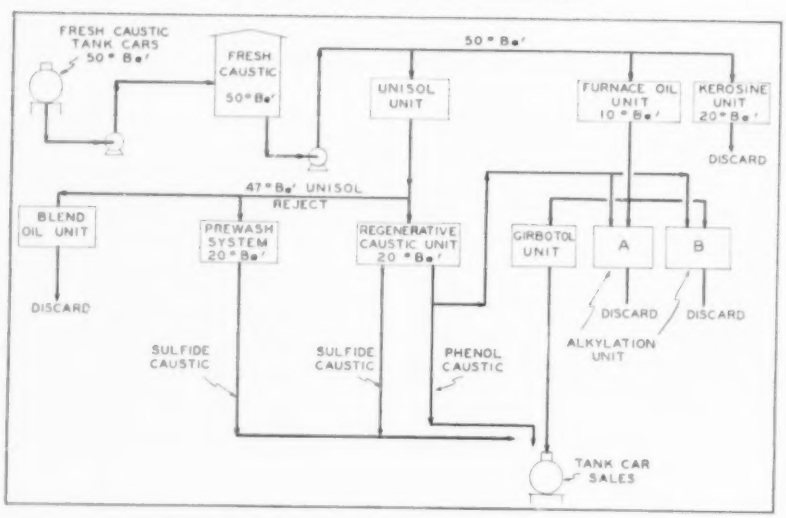


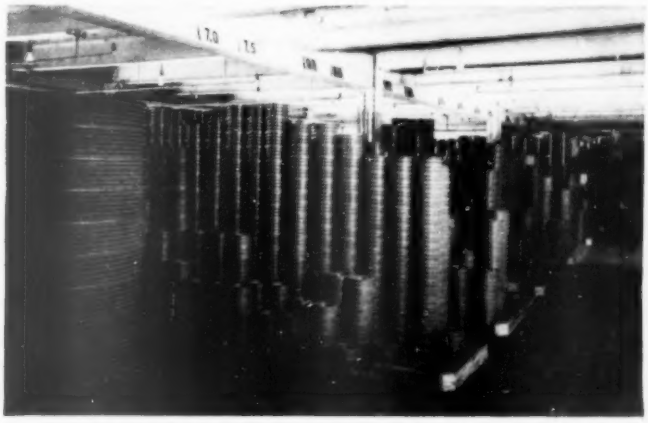
Fig. 3—Cities Service refinery caustic flow diagram.

Since the majority of these streams contain dissolved hydrogen sulfide in various concentrations, a system is provided for contacting these streams with caustic to remove the hydrogen sulfide. Recirculation-type caustic contactors are utilized for this purpose.

When the sulfide content of the caustic reaches approximately 60 per cent, the spent sulfide caustic is dumped to storage. As sufficient quantities of the sulfide caustic are accumulated, the material is loaded into tank cars and sold on the basis of the sulfide content.

There are two other units within the

How much do sheave troubles cut your production time?



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*Reg. U. S. Pat. Off.

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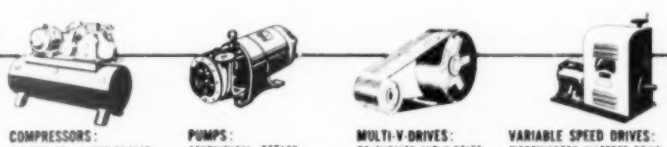

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WHITE-ROTH

treating plant which require fresh 50° B. caustic as makeup. One is the kerosine unit and the other is the furnace-oil unit.

Kerosine unit . . . Virgin kerosine produced from the topping units is treated in this unit. The unit consists of three sections, the doctor-treating section, the acid-treating section, and the clay-neutralizing section. The kerosine is first given a conventional doctor (sodium plumbite) treat to convert the mercaptans to the less obnoxious disulfides. After doctor treating, the kerosine is contacted with 93 per cent sulfuric acid to effect the removal of undesirable constituents.

Following the acid treatment, the oil is contacted with clay and filtered. The result is a consistent doctor sweet, noncorrosive 30 color (Saybolt) oil exhibiting excellent color stability. The fresh 50° B. caustic is diluted with water to the desired concentration as it is added to the doctor system. Tests have proved that only fresh caustic can be utilized as makeup to this unit if an oil having the aforementioned qualities is desired. Simplified flow diagram of the caustic unit is shown in Fig. 2.

Furnace-oil unit . . . In this unit, all of the light cycle oil produced from the catalytic cracking units destined for blending to No. 2 furnace oil is caustic treated, water washed, dried, and put to storage.

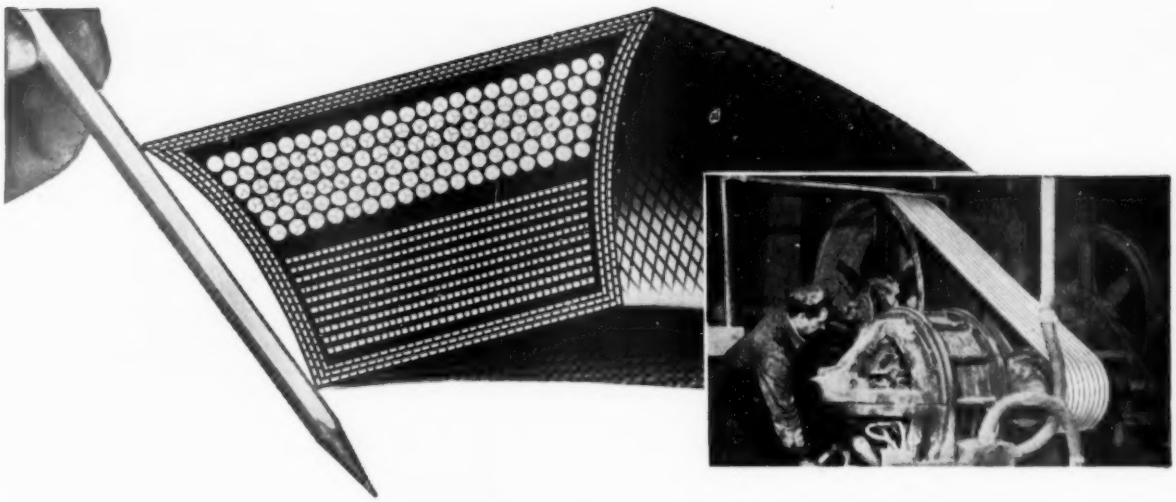
The oil is treated by contacting it continuously with a stream of 10° B. caustic which is obtained by continuous dilution of the fresh 50° B. caustic.

After use, the reject caustic is stored and pumped to the refinery alkylation units, where it is used to neutralize the effluent stream from the sulfuric acid reactors. The partially spent caustic from this process is then used to neutralize the overhead stream from the alkylation unit depropanizer. From here, the caustic is then injected into the alkylation unit blowdown drum for final neutralization of any gases injected into the flare system.

Partially spent furnace oil caustic is also utilized in the cleanup treat at the refinery Girbotol unit.

The flow sheet, Fig. 3, depicts the routing of the caustic within the refinery from the time it is received until its final disposition.

All of the fresh caustic used in the refinery is received as 50° B. liquid in 8,000 and 10,000-gal. tank cars. The caustic is unloaded at the treating plant and stored in two tanks having a combined capacity of 300,000 gal. The tanks are equipped with steam coils so that the fluidity of the caustic can be maintained during the winter months.



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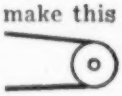

As the belt bends, grip its sides between your fingers and thumb.

If the belt has *straight sides* you feel the sides bulge out. This forces the sides of the belt to press *unevenly* against the V-pulley . . . and you get concentrated wear at the points shown by the arrows.

Now, try this same test with the V-Belt that is built with CONCAVE SIDES **—the Gates Vulco Rope.**

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When you buy V-Belts, be sure to get the V-Belt with the CONCAVE SIDES—the Gates Vulco Rope!

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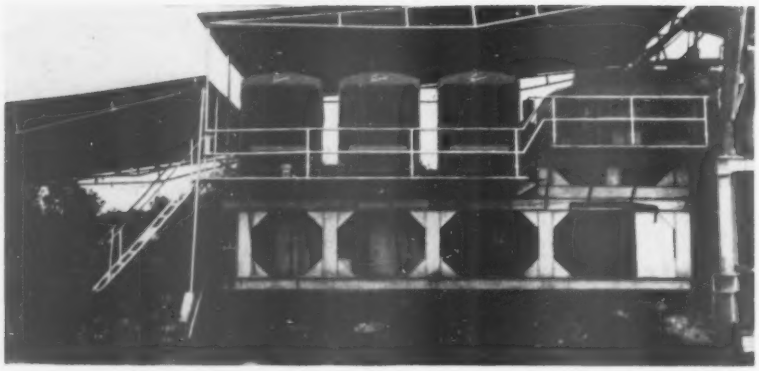

KEY LARGO WILDCAT of Sinclair Commonwealth interests, the most southeasterly drilling well in the United States today, is depicted in the above photographs. At left is the 136-ft. steel derrick and general rig view; at upper right is the Model 130 draw works powered by three 320-hp. diesel engines; and at lower right artesian water flows through the shale-shaker mounted on the return line of the fluid-circulating system. The well is situated north of Key Largo in the Straits of Florida 70 miles south of Miami.

SOUTH FLORIDA BASIN

New Development: Circulating Artesian Water For Drilling Cavernous Limestones

DRILLING ALONG THE KEYS

THE Florida Keys (or the Straits of Florida) comprise a chain of islands extending for a distance of 135 miles into the Gulf of Mexico. These extend from a point southeast of Dade County, generally southwest to Key West, where the direction is westward.

Along the Keys, five test wells have been drilled since 1946. A total of 47,867 ft. of hole has been cut; total depths of individual wells range from 6,100 to 15,455 ft.

Starting from Key Largo and traversing southwestward, these are as follows:

Coastal Petroleum Co. 1 Williams, 10 miles north of Key Largo, completed in 1950, total depth 6,702 ft.;

Republic Oil Co. 1 O. D. Robinson, in Barnes sound, completed in 1946, total depth 12,051 ft.;

Coastal Petroleum Co. 1 State of Florida, completed in 1949, total depth 7,559 ft.;

Gulf Oil Corp. 1 J. P. Scranton-State, completed in 1947, total depth 15,455 ft.;

Gulf Oil Corp. 1 State Tract 374, 16½ miles east of Key West, completed in 1947, total depth 6,100 ft.

by Joseph A. Kornfeld
District Editor

A NEW technique in circulating fluids in drilling rotary wells has resulted in considerable savings in mud costs at a Florida wildcat test. Artesian water has been harnessed in drilling through cavernous limestone formations in a deep test 70 miles south of Miami at Key Largo, Monroe County, in the South Florida basin.

The well is Sinclair Oil & Gas Co. and Commonwealth Oil Co. 1 H. R. Williams, in SW SE 24-59s-40e, now coring below 8,621 ft. on a 10,500-ft. contract. Formations to be tested include the following: basal Eocene at 4,000 ft.; the Fredericksburg limestone at 8,000 ft.; and the Sunniland limestone at 9,800 ft. The two latter formations are of Lower or Comanchean

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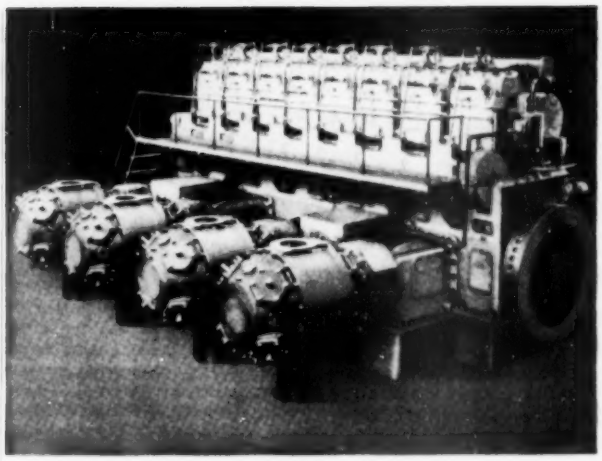

How one refinery ended lime-scale build-up in compressors

By eliminating descaling work, Southwestern company using Oakite Airefiner No. 52 also saved on downtime and maintenance

EVERY 6 to 8 weeks coolant water built up thick lime scale deposits in the water jackets of 6 compressors in this refinery. The compressors were then acidized to avoid cracked jackets. While this operation did the job, it still cost ½ day downtime plus 8 man hours. Oakite was consulted to see what could be done.

First, Oakite Compound No. 32 was used for quick, thorough descaling. Then, reasoning that preventing scale formation was even more desirable than just a better way to descale, the Oakite Technical Service Man suggested charging the 12,000 gallon spray pond with Oakite Airefiner No. 52, and maintaining the solution by proper additions. It worked wonders. No more descaling was done, no more blocks or heads cracked, no more downtime. And the compressors worked more efficiently besides, as evidenced by reduced temperature of the manifolds.

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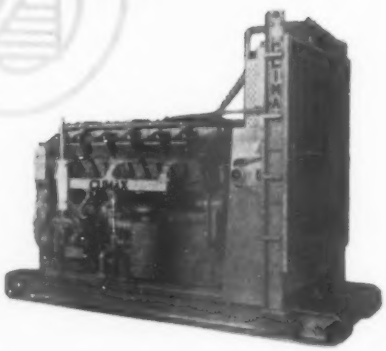

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TABLE 1—SUMMARY OF DEEP TESTS DRILLED IN DADE AND MONROE COUNTIES, FLORIDA (WELLS WHICH REACHED DEPTHS OF 10,000 FT. OR MORE)
(Data: Florida Geological Survey)

Operator, lease, and description—	Surface elevation (ft. d.f.)	Year completed	Total depth	Remarks
DADE COUNTY:				
William G. Blanchard et al. 1 Everglades, 31-53s-35e	9	1944	10,284	*Cored almost solidly from 7,408-10,284 ft.; shows of black oil from 9,445 ft. and lower depths.
Humble Oil & Refining Co. 1 Tamiami-State, 30-55s-36e	15	1945	11,789	*Cored from 2,700-10 ft. down to 11,799-89 ft.
McCord Oil Corp. 1 Damoco Oil Dev. Co.,‡ 31-53s-35e	17	1951	11,885	Wire-line cores from 9,415-10,284 ft.
MONROE COUNTY:				
Peninsular Oil & Refining Co. 1 J. W. Cory, 6-55s-34e	14	1939	†10,006	*Cored intermittently from 3,252-8,395 ft. and solidly from 8,395 to 10,006 ft.
Republic Oil Co. 1 O. D. Robinson-State, 29-59s-40e (Upper Key Largo in Barnes Sound)	23	1946	12,051	*Cores from 1,468-78 ft. to 12,050 ft.
Gulf Oil Corp. 1 J. P. Scranton-State, 2-67s-29e	23	1947	15,455	*Cores from 317-32 ft. to 15,449-55 ft. Deepest well drilled in Florida.

*Electric-log survey run on this test. †First well in Florida to reach a depth of 10,000 ft. ‡Old well drilled deeper; formerly carried as William G. Blanchard 1 Everglades

Cretaceous age. It is the second deepest well in Florida at this time.

Sinclair's Key Largo drill site, on a 1,146-acre dry-land tract, lies 94 miles southeast of Sunniland oil field, Florida's only developed oil reservoir to date. Construction of the road from the main highway to the drill site (a distance of ½ mile) started on January 7, 1953. Rig was erected and the well spudded in on January 21, 1953.

Drilling rig . . . Harry I. Morgan, drilling contractor of Shreveport, La., hauled in the rig from Mississippi over a distance of 950 miles. Forty-five tuck loads were required over a period of a single week. The draw works is powered by three 320-hp. 6-cylinder diesel engines. Two slush pumps are used.

Water supply was obtained by dynamiting a surface hole 20 by 20 ft., 12 ft. in depth; water level fluctuates with the tide. Engine-cooling water was obtained from other sources.

Cavernous Limestones

Cavernous limestones present drilling problems throughout Florida, particularly in the South Florida basin. The problem has varied with each well drilled in the state, operators having attempted various methods and devices in developing practical solutions to this drilling problem.

Conventional drilling mud was used from surface to a depth of 1,933 ft. when circulation was lost completely. Water circulation was used from the 1,933-ft. level to 3,028 ft. and the cuttings disappeared largely in the cavities. At the latter depth, an artersian flow of water estimated at 25,000 bbl. a day was encountered. Drillers attempted to shut this artesian flow off with mud without success.

Artesian water used . . . The contractor then decided to use the artesian water flow as a circulating medium. The shale shaker was placed next to the suction tank and the artesian water flowed through the shaker as shown in an accompanying photograph. The slush pumps were used to supply pump pressure for circulation. However, the supply was more than plentiful and only one-half of the artesian flow was utilized. Well-site geologists find use of artesian water for circulating a handicap in getting samples, because virtually all of the formation samples are lost in subterranean caverns.

The problem of eliminating the danger of sticking drill pipe and losing the hole arose as crews drilled below 4,000 ft. and some cuttings started to accumulate in the hole. This problem was solved by the circulation each day of about 200 bbl. of mud with a viscosity of 50 seconds A.P.I.; this practice serves to clean the hole of cuttings, most of which disappear in the cavities.

Composition of Water

Chemical composition of the artesian water sampled at 3,028 ft. showed the following principal constituents: Sample A, sodium 4,971 p.p.m., sulfate 1,379 p.p.m., chloride 9,042 p.p.m., and total solids 16,763 p.p.m.; Sample B, sodium 6,946 p.p.m., sulfate 2,069 p.p.m., chloride 12,445 p.p.m., and total solids 23,257 p.p.m.

Drilling with artesian water continued until a depth of 6,880 ft. was reached. At that depth, drilling was halted on May 1 to run 6,880 ft. of 9⅝-in. protection casing. It was cemented with 1,200 sacks of regular cement and 300 sacks of Stratacrete; cement fillup was erratic and the top of the cement was found at about 5,050 ft. Temperature survey confirmed cavity data observed during drilling with artesian water.

After the protection pipe was run, the artesian water flow decreased one-fourth in volume, and after the 72-hour waiting-on-cement time the artesian flow was cut off entirely when crews closed rams on the blowout preventer and started circulating drilling mud.

The shoe was drilled under the protection pipe with an 8½-in. rock bit with junk basket made up above bit. Two rock bits were drilled and dulled before diamond-coring operations were commenced at 7,390 ft., using an 8½-in. head.

Mud program . . . Since artesian water was discontinued at a circulating fluid at 6,880 ft., contractor first used an aquagel mud designed effectively to kill the flow of artesian water. Then the mud was converted to a lime-base fluid prior to commencement of diamond coring at 7,390 ft.

The following additives are employed in maintaining the lime-base mud:

	Amount added per day
Lime, bags	2
Caustic soda, lb.	450
Quebracho, lb.	150
Gel, sacks	12
Starch,* sacks (average)	4

*Starch is added every 3 days.

Contractor has experienced no difficulty in maintaining this mud. Mud properties at the current coring depth of 8,621 ft. are: weight, 9.1 lb. per gal.; viscosity, 38 seconds A.P.I.; and water loss, 3 cc.

Diamond coring . . . Full recoveries were obtained from diamond-coring operations conducted intermittently to 8,136 ft. in anhydrite and dolomite of Fredericksburg (Lower Cretaceous) age. However, diamond coring has been conducted continuously since 8,200 ft.

During coring, the table is turned

at an average speed of 45 r.p.m., as contrasted with speeds of 110 to 125 r.p.m. used during rock-bit drilling. Weight carried on bit is 10,000 lb. including the weight of the string of six 6¼-in. o.d. drill collars. Pump pressures during coring are 500 psi. developed by the C-350 (7¼ by 18-in.) using 6¾-in. liners. Contractor has a C-250 (7¼ by 15-in.) slush pump at the rig for standby.

Crews save as much as 1½ hours on tripping time on each run by alternating 75-ft. core barrels and heads. Core barrel is pulled at the end of a full run, the other barrel made up with a new bit and run back into the hole. After bit is back on bottom, crews break down the first barrel and recover cores for sampling and storage.

Key Largo prospect comprises one of the most prominent geophysical structures mapped to date in the South Florida basin. The 1 Williams wildcat is located on top of a anomaly exhibiting 400 ft. of closure. This feature was made known by an extensive reflection seismograph survey, which disclosed a very pronounced anticline structure trending northeast to southwest; this trend is parallel with the land position of the key. About 9,000 acres appear to lie in the area under seismic closure.

The drill site is situated on a 1,146-acre tract included in a total block comprising 165,000 acres lying in the Straits of Florida. Commonwealth leases include 6,498 acres of dry land in Key Largo and a substantial part of the remaining acreage consists largely of water bottoms. In return for drilling the well, Sinclair earns an undivided one-half interest in all acreage held by Commonwealth in the area. Sinclair is reported to have compensated Commonwealth $30,000 for seismic work conducted last year; in addition, Sinclair will pay $6,000 monthly until November 1953.

The Sinclair-Commonwealth exploratory test is located only a short distance from a 6,702-ft. dry hole drilled on the same fee ownership during 1949 and 1950. Coastal Petroleum Co. drilled its 1 H. R. Williams 10 miles north of Key Largo, but after losing tools at total depth, the well was junked.

Florida Oil—A Half-Century Search

CURRENT exploration for oil in Florida such as the Key Largo tests, may be analyzed against the background of more than one-half century of drilling during which only one field was found—Sunniland in Collier County. The earliest test drilled for oil in Florida was made at Pensacola, Escambia County, at the turn of the century. It was drilled by Escambia Oil Co. at the foot of Palavox Street in the townsite to a depth of 1,320 ft. The rig was later sold to Pensacola Development Co. which drilled two other shallow dry holes in other parts of the townsite, to 1,702 and 1,620 ft.

Prominent surface geologic features such as the "Ocala uplift" commenced receiving exploratory work as early as 1903. In that year two wells were drilled in Sumter County to depths of 1,200 and 2,002 ft. These tested surface structures in this regionally high area where the upper Eocene limestones are exposed at the surface, or only thinly mantled by more recent sediments.

From these early, shallow exploratory efforts, drilling for oil in Florida has been sporadic throughout the years. Not until 1939 did Florida receive a test well as deep as 10,000 ft. Between 1900 and 1939, 87 tests were drilled. In that latter year, a well was completed near Pinecrest in Monroe County at a depth of 10,006 ft. Drilled under the constant supervision of a trained geologist who collected cuttings and cores, this wildcat first drew attention of major companies to the oil possibilities of Florida.

This well, Peninsular Oil & Refining Co. 1 J. W. Cory, C NW 6-55s-34e, 50 miles west of Miami, was started on December 31, 1938, and abandoned on May 27, 1939, in the equivalent of the Edwards formation of Texas (Lower Cretaceous age). Oil showings were noted in limestone and anhydrite samples cored throughout the Cretaceous rocks from 8,900 ft. to total depth. Logging of extremely porous dolomitic limestone in this lower section was one factor contributing towards renewed exploration. More than 4,250 ft. of Cretaceous limestone, anhydrite, and chalk sections were penetrated; the well was completed still in oil-stained limestone with the base of the formation unreached. This deep failure proved the existence of a Cretaceous basin in southern Florida and the occurrence of a section of lower Cretaceous rocks not found elsewhere in the state; this feature pointed to a regional geologic wedge.

Encouraged by the favorable geologic conditions and oil showings logged in the Cory wildcat, Humble Oil & Refining Co. conducted during 1942 a comprehensive geological and geophysical exploration program in Collier, Dade, Hendry, and Monroe counties in the southern portion of the

PLACE-FIX MAP of South Florida showing location of current exploratory drilling wells listed in Table 2.

TABLE 2—SUMMARY OF CURRENT EXPLORATORY DRILLING IN FLORIDA
(Status as of May 20, 1953)

Map initial	County—Operator, lease, and description—	Present status	Drilling contractor
A	Glades—Coastal Petroleum 1 J. T. and William Schroeder, SW NW 25-42s-33e	Drilling 8,516 ft.	H. & H. Drilling Co.
B	Hendry—Commonwealth Oil Co. 1 Red Cattle Co., C SE SE NE 13-45s-28e	TD 5,477 ft., drill pipe stuck	Mobile Drilling Co.
C	Lee—Gulf Refining Co. 1 Consolidated Naval Stores, C NE NE 27-45s-26e	Workover rig	Dorris Ballew
D	Lee—Humble Oil & Refining Co. 1 W. E. Kirchhoff et ux., C SE NE 23-45s-24e	Drilling 5,713 ft.	Dorris Ballew
E	Monroe—Sinclair Oil & Gas Co.-Commonwealth Oil Co. 1 H. R. Williams, C SW SE 24-59s-40e	Drilling 8,227 ft.	H. I. Morgan
	Santa Rosa*—California Co. 1 Berrydale Unit, C SW SE 4-4n-27w	Workover rig	Sunniland Contr. Co.
	Walton*—A. R. Temple 1 W. B. Harberson Lumber Co., C SW SW 24-4n-20w	Rigging up rotary	Williams Inspection Co.

*In northwestern Florida (not in South Florida basin).

peninsula in what is now regarded as the South Florida basin. Favorable surface geologic data were verified by core-drilling operations conducted by Humble's own crews who worked for 36 drill-weeks near Sunniland in Collier County in Townships 47s and 48s, Ranges 29e and 30e.

The gravity-meter work by Humble in 1942 confirmed the presence of an anticlinal structural. Later the same year, Humble staked location for its 1 Gulf Coast Realties Corp. in C SW SE 29-48s-30e, 42 miles northwest of the Peninsular-Cory dry hole. It was drilled in the heart of the Everglades in the Big Cypress swamp, 30 miles west of the Seminole Indian Reservation and 40 miles southwest of Lake Okeechobee.

First oil well . . . Florida's first oil well was completed at Sunniland. This well was finaled through open-hole completion from 11,600-26 ft. Initial production was 97 bbl. of 20.8° A.P.I. oil with 425 bbl. of salt water per day; this well produced until May 14, 1946, at which time it was converted into a salt-water-disposal well on account of the high water cuts.

Subsequently, 11 additional oil wells were completed, all from the Sunniland limestone of Lower or Comanchean Cretaceous age. Current production averages 1,400 bbl. per day. In the development of the field, a total of eight dry holes were drilled in outlining the structure, which proved the field to extend 3 miles from the discovery in a northwest - to - southeast trend. In addition to these 20 test wells drilled within the immediate vicinity of Sunniland, several outpost tests have been drilled to depths as great as 13,400 ft., without success.

Of these producing wells, eight are situated on properties of the Gulf Coast Realties Corp. and the remaining four are completed on properties leased from Lee Tidewater Cypress Lumber Co. Produced gas-oil ratios are very low, being in the order of 100 cu. ft. per bbl.

Cumulative production from the field to January 1, 1953, was 8,786,199 bbl. During 1952, oil production totaled 2,766,469 bbl., the largest for any single year.

Pumping is continuous and pumping depths range from 2,500 to 7,500 ft. Fluid recovery ranges from 40 to 200 bbl. daily; and the salt-water cuts range from 12 to 75 per cent per well. Production facilities include separator system, heater-treater, and lease storage.

After the crude is gathered to central field storage, production is moved by a fleet of tank trucks operated by a commercial carrier between the field and storage facilities at Port Everglades on the east coast 150 miles east of the field. At this port, crude volumes up to 100,000 bbl. are collected and then shipped to eastern refineries of Standard Oil Co. (N. J.) with which Humble is affiliated. Transportation charge for the truck operation is approximately 40 cents per barrel.

BOOK

GASIFICATION AND LIQUEFACTION OF COAL. A Symposium. Published by American Institute of Mining and Metallurgical Engineers, 29 West Thirty-ninth Street, New York. 221 pp. $6; $4.20 to A.I.M.E. members.

This volume reflects new and current developments described by research men in operations dealing with improved techniques of gasification, plant design, direct hydrogenation, chemical output, underground gasification, and gas economics. Of the 15 papers contained in the symposium, 7 describe new modifications of gasification processes; 1 reviews trends in the gasification of coal; 2 deal with hydrogenation, and 5 discuss the significance of successful coal gasification to American industry. The papers give some interesting highlights on the problems encountered in the development of the proposed gasification processes such as the removal of ash or slag, the avoidance of carryover of large amounts of fine particles, the minimizing of wear on refractories or other materials of construction, the introduction of the coal and gaseous reactants into the gasification space, and the securing of maximum thermal efficiency.

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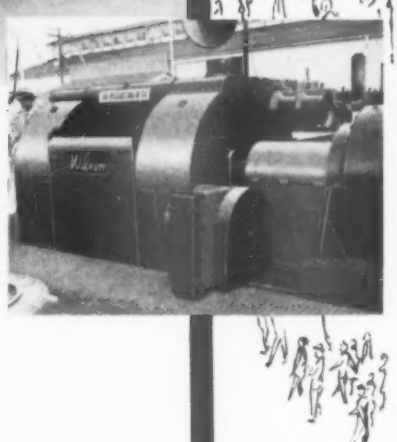

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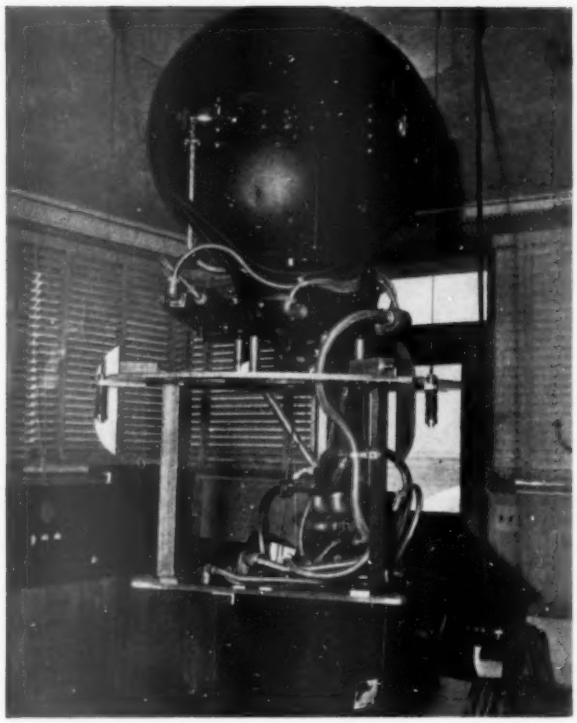
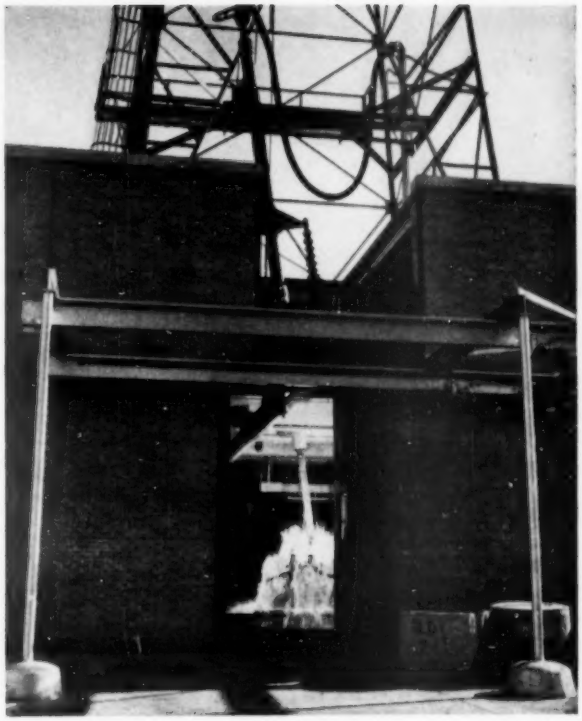
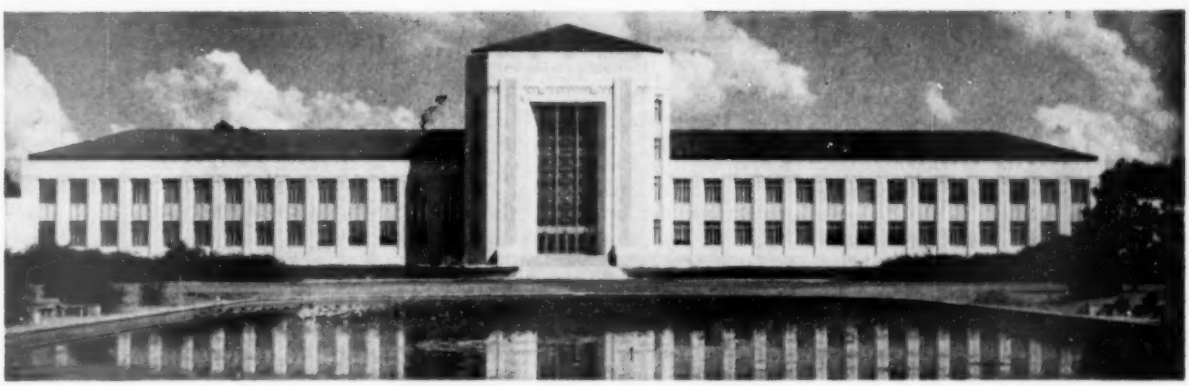


Experimental radar installation at Humble's geophysical field station at Friendswood, Tex.



Hughes Tool Co. laboratory drilling rig. Drill stem can be inclined as much as 10°.

Gulf Coast Operators... Manufacturing Suppliers...



Administration building of University of Houston.

And Universities Contribute to Expanded Research

by C. Malcolm Davis

RESEARCH facilities and the scope of research work have expanded considerably over the last few years in the Gulf Coast area. Some of the representative companies which conduct research and development work and some of the universities identified with research work are described here.

Drilling Research, Inc.

Drilling Research, Inc., is an organization which has been formed by 44 oil companies and drilling contractors for the purpose of devising new and economical ways of drilling oil wells.

Dr. E. C. Pennington and his secretary comprise the actual office organization, at Houston. Pennington, as technical director, evaluates research proposals which have been received and plans the research work which is farmed out, for the present, to Battelle Memorial Institute, of Columbus, Ohio, and Columbia University, of New York City.

Experimental drilling work is now being conducted in the laboratory and

Harvey B. Kennedy and R. B. Evans, Texas A. & M. College, with high-pressure gas solubility equipment, employed for Texas Petroleum Research Committee projects.

Dr. Paul Crawford, at left, of the Texas Petroleum Research Committee which administers petroleum research projects jointly between University of Texas and Texas A. & M.

in stone quarries. One method of drilling which is receiving specific attention uses the principle of high-frequency vibrations.

Each quarter a progress report is prepared by the technical director for review by a committee of the oil companies and drilling contractors who formed the research organization.

Gulf Oil Corp., Houston

RESEARCH in production started in 1917 with Gulf, at Houston, on the problems of the production of petroleum.

The work of the division chemical unit, conducted for the Gulf Coast area, is primarily practical investigation of production and pipe-line problems. The activity pertaining to testing and preparation of specifications covers oil-well cements, drilling-mud materials and paints.

Finding out the "whys" on causes of corrosion is carried out by this Gulf unit, and methods of mitigation are sought. Constant attention is given to improvement in compounding and handling drilling muds, in cementing techniques, in methods for disposing of salt water, and in water treating for water-flood projects. Also, phase-equilibrium studies are made on reservoir fluids. Pure and applied research as such on broad scale done by Gulf's research laboratory at Hammarville, Pa.

Key personnel for the Gulf unit at Houston are: W. F. Rogers, chief chemist; J. P. Sloan, assistant chief chemist, P-V-T and phase equilibria; H. E. Waldrip, supervisor, corrosion, paints, salt-water disposal, and W. C. Goins, Jr., supervisor, mud and cement.

Humble Oil & Refining Co.

GEOPHYSICS research of Humble began in 1924, geochemical work in 1937, and geological research in 1947, although some geological work as such had been done earlier. These branches comprise the exploration research.

Production research was started in 1929 and drilling and equipment research in 1945; however, equipment development had been done earlier.

Early in 1945 research and development work was centralized under Dr. H. D. Wilde, who is responsible for research and development work in the production and exploration departments along with both technical service and research and development work in the refining department.

The new Houston research center of Humble will be ready in the fall of this year. Exploration and production problems will be worked on in the new quarters.

The geophysical experiment station at Friendswood, Tex., permits field experimentation on geophysical equipment and techniques. It has been open since late 1950.

Key personnel and positions include: Dr. H. D. Wilde, manager of research and development; Dr. W. M. Rust, Jr., chief of geophysics research; D. H. Gardner, assistant chief of geophysics research; Dr. H. N. Fiske, chief of geological research; S. E. Buckley, head of production research; Dr. C. R. Hocott, assistant head of production research, and T. J. Fuson, chief petroleum engineer (drilling and equipment research).

The Texas Co.

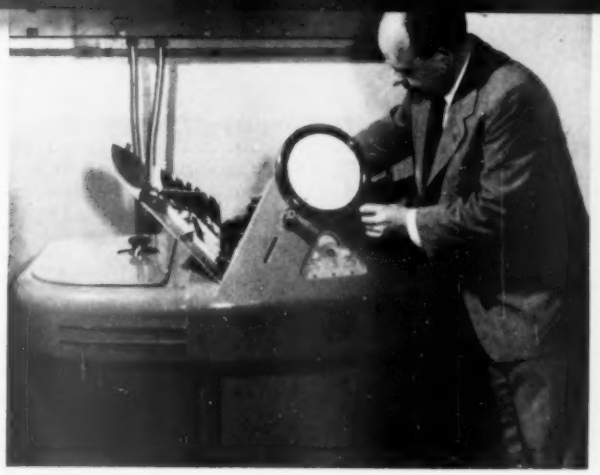
EXPLORATION and production research is conducted for company activities all over the United States at the Bellaire, Tex., laboratories.

Geophysical work, drilling-muds investigations, P-V-T behavior, and other aspects of exploration and production research are carried out.

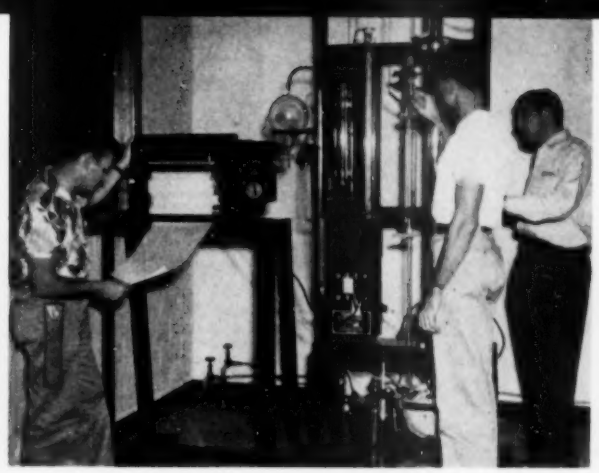
Hughes Tool Co., Houston

A FIELD-SIZE drilling rig with a 118-ft. derrick rises about 90 ft. above the roof of a new drilling laboratory. The substructure is situated at ground level about 15 ft. beneath the rotary or working floor of the derrick. The working floor of the rig is actually the ceiling of the drilling laboratory. The area under the rotary is where the drilling actually takes place. Here the

The Texas Co. production department research facilities. Exploration research building is in foreground. At extreme left is the production research laboratory.



W. O. Milligan, of Rice Institute, operating mass spectrometer.



Natural-gas fractionation studies with Podbielniak equipment at Texas A. & I. College.

operator makes his observations and measures the performance of bits undergoing tests. Drilling is controlled from a booth about midway between the ceiling of the laboratory and cellar floor.

Drilling loads can be carried up to 100,000 lb. with a hydraulic pull-down yoke attached to the drill stem just above the rotary table. It is located between the ceiling of the laboratory and the roof of the building. Rotational speeds as high as 400 r.p.m. can be employed during drilling tests.

New drilling techniques are investigated. For example, a rotary type, fluid-actuated percussion drilling tool and its bits are tested. Variations of the basic design are also investigated. A specialized setup allows for a study of jetting action of jet bits.

The supporting laboratories afford facilities to make full studies of the strength of metals and to determine the best metallurgical processes for making the specialized metals required for bits.

Key personnel: D. J. Martin, vice president, engineering, under whom are three engineering departments responsible for the research, design and development work having to do with the manufacture of the company's products.

Departments are: Research engineering under F. L. Scott, research director; project engineering, under L. L. Payne, assistant vice president, engineering; and metallurgical engineering, under R. W. Schlumpf, chief metallurgist.

The company's research and engineering laboratory acts as a division of the metallurgical department and heading this division is W. R. White, laboratory director.

Schlumberger Well Surveying Corp.

AT the new $6,000,000 plant in Houston certain developmental research is conducted. The Schlumberger research laboratory in Ridgefield, Conn., has been enlarged since 1948 to about five times its original size.

Due to intensive research four Schlumberger services were added to field operations in 1952. These were: (1) Neutron logging, (2) Microlaterologging, (3) the Teleclinometer dipmeter, and (4) the Erpendable shaped charge.

Reed Roller Bit Co.

FOR more than 20 years, Reed Roller Bit Co. has maintained a formal research department with a constantly growing program. In the early days, most research was in the field of product design. This continues today on an even greater scale, but research in the fields of metallurgy, hydraulics and geology occupies a growing percentage of attention.

Metallurgical research facilities . . . The metallurgical department, under the direction of Nolan Clark, is in four divisions: (1) chemical research, (2) physical-testing research, (3) heat-treating research, and (4) radiation studies.

A completely equipped chemical laboratory is used to carry on studies of the chemical composition of steels in a constant effort to find an analysis which will give better performance characteristics for the individual parts and products.

The physical-testing laboratory includes, in addition to conventional physical testing machines, extensive stress and strain analysis equipment. The heat-treating-research division contains a precison carburizing furnace and salt-bath heating furnaces. Extensive studies carried on in these phases of heat treating have resulted in new methods of heat treating for rock bits. The radiation laboratory has equipment for carrying on X-ray diffraction studies of metals and gamma-ray work.

Hydraulic research facilities . . . A hydraulics laboratory under the direction of E. G. Boice is used to study the hydraulic aspects of rotary drilling. A 600-hp. pump is capable of build-up pressures across nozzles on the order of 5,000 psi. This permits engineers to explore the behavior of nozzles with fluid velocities as high as 600 ft. per second. High-speed movie-camera equipment is provided to explore the flow pattern of fluids through nozzles at these high velocities.

Geological testing facilities . . . Of particular interest to bit users is the geo-

This X-ray diffraction instrument in the Reed Roller Bit Co. radiation laboratory is employed for studying the crystalline structure of metals.

logical laboratory where studies of factors influencing drillability of various formations are made.

Shell Oil Co.

THE general program of research of Shell at Houston is divided into the three branches of physical, chemical, and geological sciences, with the division consisting of these three departments. Fundamental studies of the physics and chemistry of the earth and studies related to geology are being pursued.

Coordination between research and the field is a keynote of the program. Frequent trips are made to the field to conduct tests. The physicists study the propagation of elastic waves in the earth and the phenomena connected with the earth's gravitational, magnetic, and electric fields. Instruments and techniques are developed for measuring these properties from the surface to depths of 5 miles.

An artificial oil well makes it possible for Shell to carry out tests under pressure up to 10,000 psi. and temperatures as high as 300° F.

Colloid chemists and inorganic chemists study the properties of rocks and assist in developing special drilling muds for deep-well drilling. Shell geological investigations cover the fields of stratigraphy, sedimentology, petrology, tectonics, geochemistry and geophysics. Research goes into factors dealing with deposition, diogenesis, and deformation of sedimentary rocks as releated to origin, migration, and accumulation of petroleum. Improvements in petrographic, paleontological, lithological, and field analyses are brought about by stratigraphic research. Also Shell has evolved methods of identifying, correlating, and evaluating reservoir rocks and related sedimentary masses.

Texas Petroleum Research Committee

THIS organization, which carries on its research activities at Texas Agricultural and Mechanical College and at University of Texas, started its work in production in November 1947. It was created to develop a program in petroleum engineering with particular emphasis on problems of secondary recovery of oil, and improvement of primary recovery methods. Further, it seeks any practical means to increase the total quantity of oil recovered from Texas oil fields.

The over-all work of the organization includes oil-reserves survey, petroleum-engineering research, and oil-recovery conferences.

Oil-reserves survey . . . This task for the some 3,200 oil fields consists of estimating original oil in place, and studying the primary and secondary recovery of oil for all the fields in the state.

Petroleum-engineering research . . . At Texas A. & M. studies receiving attention are correlation of K-values on hydrocarbon systems, application of nuclear magnetic resonance for determining reservoir core and fluid properties, studies of fractured and heterogeneous reservoirs, study of criteria for determining maximum efficient rates of production, criteria to determine when to initiate a pressure maintenance program and what fluids to inject, and economic study of various new oil recovery methods.

Research projects under way at University of Texas include prediction of field K_g/K_o ratios, influence of the injection of air gas mixtures in a gravity drainage system, solubility of a high-molecular-weight hydrocarbon in a gas at elevated pressure and temperature, methods of increasing oil recovery from the Spraberry formation, effect of slow-acting acids on the Spraberry formation, and design and fabrication of P-V-T equipment and auxiliary equipment.

Key personnel and positions include: W. J. Murray, Jr., chairman and member of Railroad Commission of Texas; H. H. Power, University of Texas; G. W. Hough, University of Texas; A. B. Stevens, Texas A. & M. College; R. L. Whiting, acting director TPRC, Texas A. & M. College; P. B. Crawford, assistant director.

University of Texas

THE first degree by University of Texas in petroleum engineering was granted in 1932. Research now in progress includes a study on the effect of wetting agents on gravity drainage and the prediction of field behavior, and a study on the effect of contact angle on relative permeability.

The acid treatment of formations is being studied and the spectrographic analysis of reservoir rocks continues.

Surface forces at pressures up to 10,000 psia. and volumetric properties of heavy hydrocarbons up to 10,000 psia. are being studied.

Key petroleum engineering personnel and position held include: H. H. Power, chairman and professor; C. W. Hough, professor; F. W. Jessen, visiting professor; J. P. Roston, assistant professor; C. W. Larkam, lecturer; and I. F. Roeback, teaching fellow.

Texas College of Arts and Industries

PRODUCTION and exploration research began in September 1946. Research work under way includes:

1. Investigation of ground water resources in Kleburg County, Texas.
2. Electrolytic model studies of natural gas reservoir performances.
3. Study of all phases of the odorization of natural gas.
4. Calibration of flow beans.
5. Field study of the application of diffuser in compression of natural gas by means of high-pressure motive gas.
6. Corrosion problems encountered in connectors joining copper and aluminum conductors.

Key personnel and positions include: F. H. Dotterweich, director; C. V. Mooney, professor; E. Korges, professor; J. B. Guinn, professor; M. W. Truitt, professor; and P. Treptow, instructor.

University of Houston

THE University of Houston started its production research in January 1953. Current work includes long core studies under compaction pressure with displacement of oil by water, of water by oil for various mobility ratios. The cores contain varying amounts of clays. Each core experiences a quantitative electric-log evaluation under the predescribed conditions. Further, the swelling effect and formation-factor determination of different types of clays for different water salinities are being made also.

Equipment consists of two 12-ft. sections of 7-in.-diameter 5,000 psi. (working pressure) flanged pipe designed for the long-core studies, under gas flow. In addition, one 3-ft. section of 4-in.-diameter 1,000 psi. pipe apparatus is fitted for compaction pressure studies, using a rubber sleeve.

Key personnel and positions include: C. V. Kirkpatrick, professor of petroleum engineering; Park Jones, professor of petroleum engineering.

Lamar State College of Technology

THIS technical school is in its second year as a 4-year senior college in Beaumont, Tex. Research work is already in progress.

Research on filtration and flow of fluids through permeable solids in the chemical engineering department has just been completed. Equipment was employed for studying a constant filtration rate. New equipment is being constructed to determine liquid pressure drops through fixed beds of solids.

Further, testing of theoretical equations in batch rectification with experimental data is going on. The hydraulics involved in distillation-plate design along with plate efficiencies is being studied.

The design of the equipment is making possible a complete equilibrium curve in the matter of 1-2 hours.

The electrical engineering department is making a preliminary investigation of applications of an analog computer. This work should indicate whether the local oil industry has sufficient need for a computer.

Key personnel on research include: F. M. Tiller and C. E. Huckaba, chemical engineering; D. H. DeSutter, electrical engineering, and W. J. Conner, mathematics.

Temperature Surveys

(Continued from page 171)

depths where the mud temperature is greater than formation temperature (see Fig. 1), and in this section there may be a slight cooling of the mud between runs. Too, the temperature-surveying instruments are not always sufficiently accurate to allow this kind of comparison.

The second part of Fig. 2 shows the type of break in temperature gradient that is caused by an attempt to establish circulation following a loss. Here the mud below the bit was heated with time while circulation above the bit cooled the mud. Such situations can usually be resolved by questioning the rig crews as to attempts to circulate and the location of the bit at that time. In this instance the answer was clearly evident since the mud just above this point was not cooled by the pumping of mud between runs.

There is another condition which creates temperature anomalies in well bores and these could also be mistaken for zones of loss. Sedimentary deposits vary in heat capacity and conductivity. As a result the mud temperature will show small varations from bed to bed, even though there is a definite over-all gradient in the well. Some use has even been made of these variations to determine the kind of fluid content in porous zones, e.g., Reference 1.

At logging rates of 100 to 150 ft. per minute these small variations are smoothed because of the lag of the instrument in recording temperature changes. Slower rates will show these changes more accurately, but for the purpose of this use the faster rates are recommended. However, even at the slower rates the break in temperature gradient caused by displacing mud is usually so pronounced that there is little difficulty in distinguishing the zone of loss from the areas of small temperature variations.

Fig. 3 shows all four logs recommended in the procedure. These were made in the same well as the logs in Fig. 2 but at an earlier date. The difference in temperature recorded on the "down" and "up" runs is clearly shown. As already explained, the top of the break on down runs and the bottom of the break on the up runs are believed to indicate the thief zone.

Fig. 4 shows two downward logs made in a well at 50 ft. per minute. Large fluctuations in temperature are evident due to salt-water sands and a slow logging rate, but the zone of loss is clearly indicated.

Fig. 5 shows a fluid level located in a well by temperature survey. Where attempts are made to fill the hole with water, the water-mud contact can also

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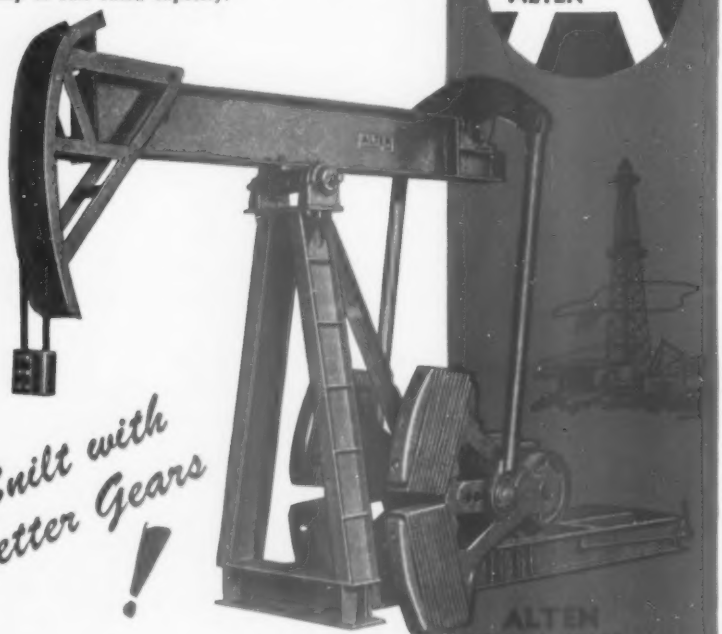

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be located. With the fluid level down in a well there is always the possibility that added mud or water has raised the fluid level rather than causing a mud displacement in the hole. Locating the fluid level and water-mud contact is often of aid in determining whether sufficient mud has been displaced to create a sharp temperature break at the point of loss. Also, it may be desirable to calculate from such data the hydrostatic pressure that the formation is capable of supporting.

In the event that there are two separate losses there will probably be two temperature breaks. The top break will not be as pronounced as for a single loss and will extend over a longer interval. The lower break will be similar to one for a single loss but not as pronounced. Above the top loss the difference in temperature between runs will be greater than at points between the losses. Several runs may be necessary to locate two points of loss, but they can be found by this method.

If the point of loss is on bottom, as appears to be rarely true in the Gulf Coast area, the pumping of 1,000 ft. of mud will cause a reduction in temperature at all points from surface to total depth.

Previous experience[3] with a more definitive but less reliable method for locating losses has led the authors to believe that many Gulf Coast losses are over intervals of one foot or less. The temperature-survey method as described here is not capable of such close definition of loss zones, but the location of losses to within even a 50-ft. interval is sufficiently accurate for most squeezing operations.

Although not as yet attempted, closer definition may be possible after the general zone of loss is located. One possibility is through rechecking the zone at slower logging rates. Another would be to use the instrument as a flow-detection apparatus on the assumption that a still instrument would register a temperature change when flow is started by it. By this method, points of flow and nonflow might be determined, and if the loss is to a narrow fissure, it could be closely located.

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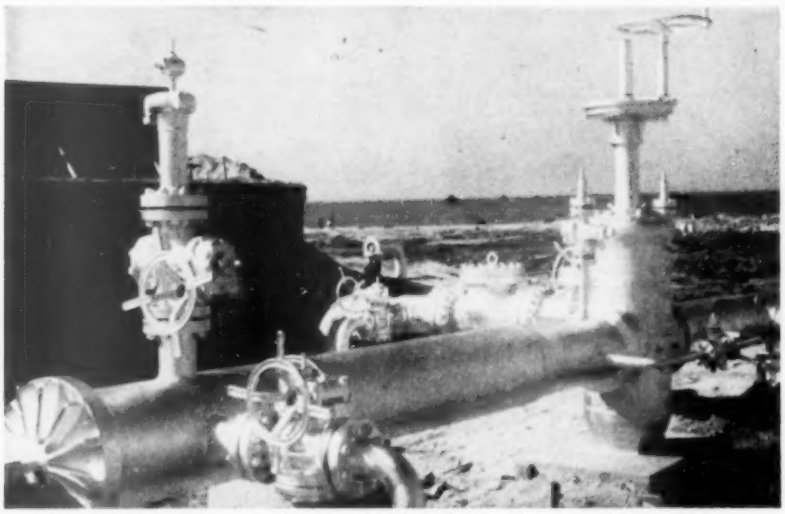
Acknowledgment

The authors wish to express appreciation to Gulf Oil Corp., and in particular to the Houston production division for permission to publish this paper.

SANDBLASTING is a vital part of metalizing process. In addition to cleaning surface, the sand roughens it to insure bond between base metal and zinc.

METALIZING with high-purity zinc. Wire is being fed into gun which melts the wire and sprays molten zinc on base metal.

Fighting Corrosion at a Gulf Coast Terminus



SCRAPER-TRAP INSTALLATION after metalizing and painting were completed.

. . . by metalizing parts with zinc

by F. Lawrence Resen
Gulf Coast District Editor

PIPE-LINE installations on Mustang Island in outer Corpus Christi Bay have been metalized by United Gas Pipe Line Co. as a means of combating corrosion in this Gulf Coast locality.

The metalizing process which consists mainly of spraying a coat of melted zinc upon equipment to be protected, was applied to scraper trap and exposed piping and valves at United's terminus on the island.

The particular installations on Mustang Island are typical of many others along the coast in that they are subjected to salt-water spray together with being exposed to relatively high atmospheric temperatures. The zinc layer was covered with a vinyl coating, applied to offset the highly corrosive effects to which the installations are constantly being subjected. Aluminum paint was added for improving the appearance.

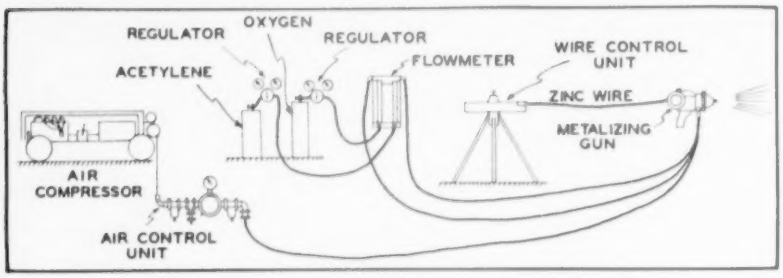
A zinc coating with a minimum thickness of .010 in. was applied to exposed surfaces which amounted to approximately 5 oz. of zinc per sq. ft. of surface. While this thickness is a bit higher than manufacturer's specifications—these conform to installations where salt-water immersion is the prime consideration—it was felt that the severity of conditions warranted the extra protection.

Process . . . In the metalizing process at Mustang Island, the equipment and piping to be coated were first sandblasted to both clean the surface and to roughen it to improve the bond of the zinc to the base metal. Since the surface conditions were extremely important in this process, a special grade of sand, Flintbrasive Sand Grade No. 7, was used to clean the base metal to a white metal finish. Application of the zinc to this surface was done as soon as possible after the blasting to insure that the surface would not be contaminated in the intervening time, and an hour was set as the maximum time between sandblasting and metalizing.

To insure purity of coating zinc wire was laboratory grade and cost slightly more than commercial high-purity zinc. Operations were governed by climatic conditions and were shut down when spray was excessive or mist and fog were present, which would contaminate freshly blasted surface of the base metal.

In applying the zinc, a special gun is used which melts the metal and then sprays it in molten form over the surface. The zinc, in solidifying, there-

All exposed portions of installation were metalized, including valves, fittings, scraper trap, and piping.



Schematic diagram showing operation of metalizing guns.

upon forms a clad bond with the base metal, but does not overheat the base metal. After solidifying, the coating was checked with an Elcometer magnetic thickness gage to insure a minimum thickness of .010 in. as specified. Where the thickness was less than the minimum, an additional pass with the metalizing gun was made to bring it up to specifications.

All aboveground piping and equipment were coated and in those instances where the piping went underground, the dirt was dug away from around the pipe and the section would be coated down to where underground enamel coating had been applied. After the zinc had been applied, two vinyl seal coats were applied to the installation and then a finish coat of aluminum paint was used to "dress up" the site.

How the gun works . . . The metalizing gun is somewhat larger than a paint spray gun, and has incoming lines attached which feed compressed air, oxygen, and acetylene to its nozzle. The oxyacetylene mixture is ignited and used to melt the zinc, which is injected into the gun in wire form. The compressed air, at about 60 psi. pressure, sprays the molten metal onto the base metal.

The operator holds the gun between 4-10 in. from the surface and uses it similar to a paint sprayer.

The equipment required, in addition to the gun, includes air compressor, air control unit, acetylene and oxygen supply (conventional tanks) plus flowmeter, a wire control unit for supplying gun with zinc wire, and associated lines for carrying gases and air to gun.

Pipe-line treminus . . . The location of the installation is the terminus of United's recently completed Mustang Island-Refugio pipe line, a 44-mile line laid 10 miles under the bay and 34 miles overland to transport gas from coastal wells to the Refugio compressor station, also recently completed. The 16-in. line takes gas from a number of delivery points in the bay area, terminates on the inward, or bay side of the island, several hundred feet back from the water's edge. The island is a long, sandy strip of land, ranging in width up to several miles across that parallels the coast and separates Corpus Christi Bay from the Gulf of Mexico. On its edge and under the bay waters of its inland site lies Mustang Island-Red Fish Bay oil and gas distillate field, one of the major discoveries of recent years in the Gulf Coast area. When the winds are from the northwest, the island is subjected to spray. At times the conditions are such as to cover portions of the island completely with salt water, but the main corrosion problem is caused by the spray, and it was to combat this that the metalizing was effected.

The work on the project was performed by the metalizing division of Kosson Richards Co., Houston.

Acknowledgment

Preparation of this article was accomplished through cooperation of W. P. Heineman and D. L. Callahan, both of United's engineering department. Accompanying photographs were taken by Callahan.

Geology of the Gulf Coast

(Continued from page 251)

existed prior to faulting and that they were formed by arching, either as a result of deep-seated salt movement or differential compaction over deeply buried sands or reefs. Other geologists believe that the folds developed prior to rupture as excess seaward loading developed down-to-the-coast flexures in semiconsolidated sediments. Reversal of seaward dip is attributed to stretching and local subsidence over the zone where rupture will occur later—a structural development analogous in some respects to bending of beds on the margins of a depressed, crustal segment which will become a graben after rupture. Dips toward the graben may persist after rupture, particularly where unconsolidated, semiplastic sediments are involved.

Another explanation of the spatial association of anticlines with a regional down-to-the-coast faults is that folding is the result of seaward slip along faults which steepen as they approach the surface. The hanging wall blocks, as they slide seaward on these "concave upward" fault surfaces, are rotated so that the original, seaward dips are reversed. Familiar, small-scale examples of movements of this nature can be seen on hillsides where sliding has created terraces immediately below slide scars.

The position or positions of the Gulf of Mexico geosynclinal trough during Cenozoic cannot be determined from existing, subsurface geologic data, as nearly all formational units continue to thicken seaward to the deepest positions penetrated by the drill. Thus all exploration up until the present has been on the homoclinal, northern limb of the geosynclinal trough.

Differential crustal subsidence has been the dominant process in the structural evolution of the Gulf Coastal area during the Cenozoic. The only structure that originated from tectonic forces appears to be the Gulf Coast geosyncline. Subsidence and loading on the flanks of this structure have been directly or indirectly responsible for the almost infinite variety of strain patterns that were developed on both local and regional structures as the result of tensional stresses.

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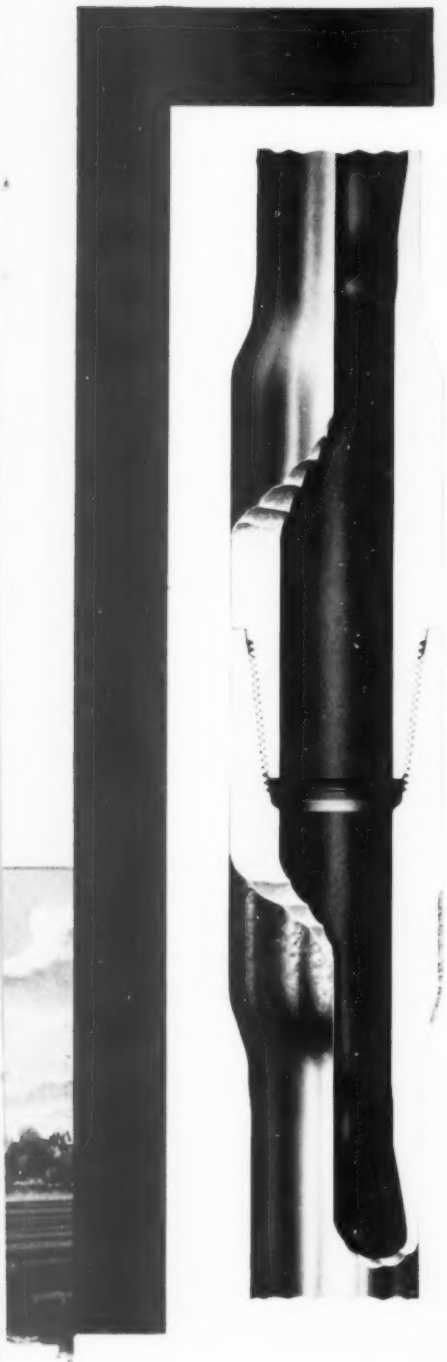

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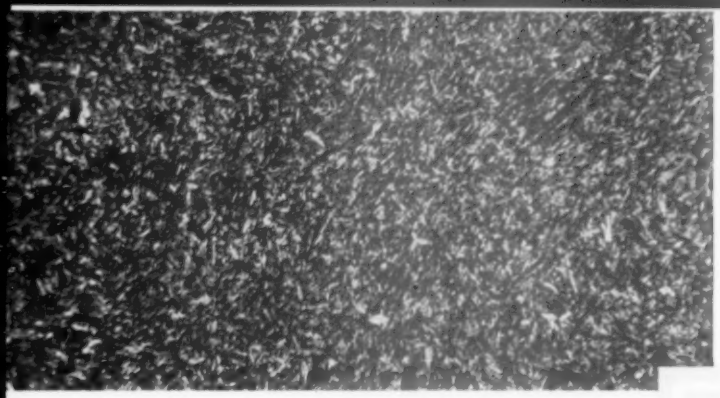

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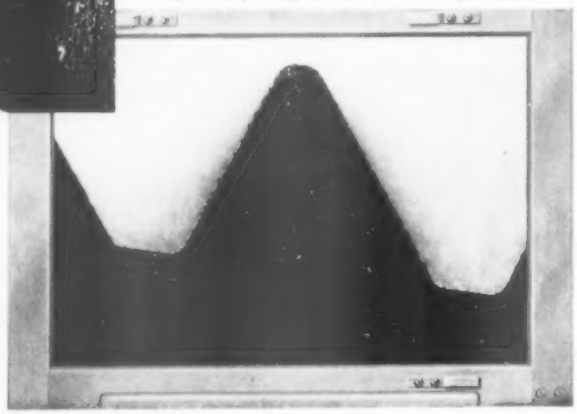

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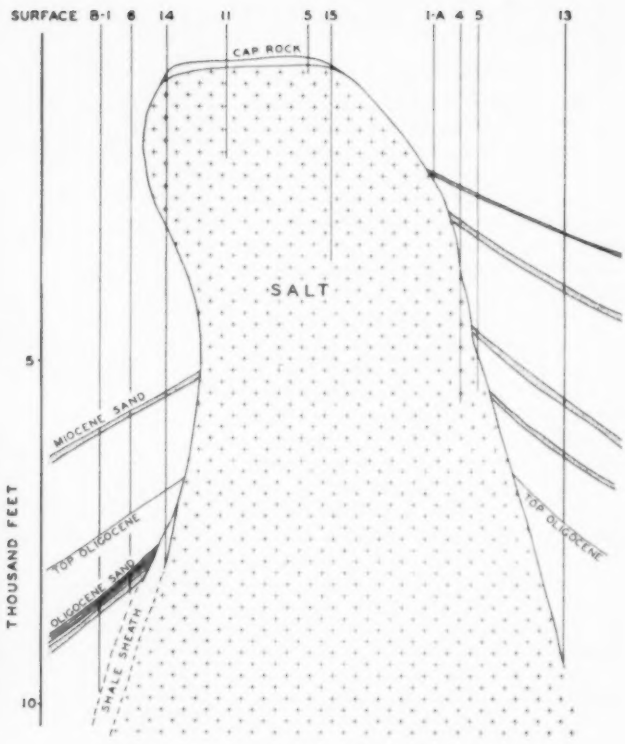
Drilling well in Bayou Choctaw field.



East-west cross-section of Bayou Choctaw salt dome.

GULF COAST FIELD REPORT

Bayou Choctaw Salt Dome Producing 3,000 Bbl. Daily, After 22 Years

Three operators control production from field's 54 producers

by Donald D. Utterback

BAYOU Choctaw field in Iberville Parish, Louisiana, is illustrative of the challenges of the Gulf Coast salt domes. This field, covering but a little more than 1 sq. mile, is producing 3,000 bbl. daily, after 22 years of development and production. More impressive, however, is the fact that unexplored areas on the flanks of the dome are greater than those developed to date.

It is estimated that about 1½ miles of additional flank remains to be explored for Miocene possibilities, about 2 miles of flank for the regular Oligocene producing sands, and that between 4 and 5 miles of flank remain to be explored for deeper Oligocene possibilities. This compares with the record of 22 years of development which has accounted for Miocene production on about 1¾ miles of flank, development in the regular Oligocene sands on about 1½ miles of flank, and incomplete exploration for deeper production at three isolated spots.

History

The Bayou Choctaw salt dome was discovered in 1926 by refraction seismograph conducted by Gulf Oil Corp. Various companies have held and relinquished leases both before and after the drilling of the discovery oil well. The discovery well was Standard Oil Co. of Louisiana (now Carter Oil Co.) 1 Gay Union completed in June 1931 producing from a Miocene sand at 4,289-4,353 ft. The dome has been under practically continuous development since that time. Activity has varied from moderate intervals of no drilling to a peak of five rigs running at one time.

Since the discovery well, 76 wells have been drilled for oil and gas. The resulting 54 producers had accounted for a total production of 6,112,711 bbl. of oil to the end of 1952. Sulfur possibilities of the caprock have been tested by 8 wells and 16 wells have been drilled into the salt for the production of brine. At present, oil production is controlled by three operators. Carter Oil Co. controls the deeper east flank and some settled Miocene production on the southeast; Temple Hargrove et al the outer north and west flanks; and Freeport Sulphur Co. the remainder. Daily production is about 3,000 bbl. of

oil, almost equally divided among the three operators.

Physiography

The dome is located about 5 miles west of the Mississippi River and about 6 miles west-northwest of the river town of Plaquemine. Physiographically it is in the timbered swamp at the eastern edge of the Atchafalaya River Basin, a short distance west of the cultivated area of the Mississippi River natural levee.

Until the building of the Atchafalaya floodway levees it was inundated each year during the flood stage of the rivers. Since then the area has been protected from flood water and high water is limited to the effects of local rainfall. In the early days of exploration the only means of access was by boat from the west leaving from a landing reached from the town of Plaquemine by a road along the natural levees of Bayou Plaquemines and Bayou Grosse Tete. A canal system was due to provide transportation to the various parts of the dome. The area is now accessible by gravel road from a paved highway along the Mississippi River. A master system of graded roads has been built to important areas of development. Access to individual locations is by board roads built on a low fill.

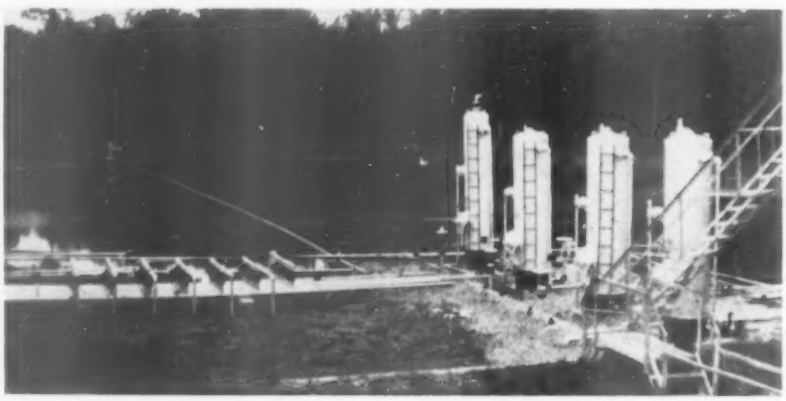
Geology

At the 8,000-ft. salt contour the dome measures about 1 mile from east to west and about 1¼ miles from north to south. Limestone, gypsum, and anhydrite caprock is found over the shallow portions of the dome. The shallowest caprock reported is at a depth of 237 ft., the deepest reported is 1,215 ft. No oil production has been found in the caprock. It was explored for sulfur in 1930 and 1931 and has also been drilled through by numerous brine wells. On the west side a few wells drilling for oil under an overhang have penetrated some caprock at shallow depths.

To the depth that it has been drilled the salt slope varies from steep to overhanging. Production has been found under the overhang as well as on the steeply dipping flanks. The most extensive overhang is on the west side where in one well over 2,200 ft. of salt was drilled before going back into clastic sediments. Six wells have been drilled through this overhang, all of which were productive.

The shallow sediments over the top of the dome and on the flanks to a depth of about 7,000 ft. are undifferentiated Miocene and younger. The total thickness over the top is probably Recent and Pleistocene. To the base of the Miocene these consist of sands with subordinate amounts of shales. Below the Miocene are Oligocene shales and limes with subordinate amounts of sands. (The terms Miocene and Oligocene are used here in their original Gulf Coast sense which, at this position on dip, identifies the top of the Oligocene as the base of the massive Miocene sands and coincides with the first appearance of large Discorbis.)

Portion of Bayou Choctaw field after a rain.



Manifold and separator battery serving seven wells in Bayou Choctaw field.

Producing horizons . . . Oil and gas production has been found only on the flanks of the dome. It has been obtained from several horizons in the Miocene and from the lower Marginulina zone of the Oligocene. Miocene production varies from 2,000 to 5,500 ft. in depth. Producing depths in the Oligocene are from 7,500 to 8,600 ft.

Complex faulting and pronounced sedimentary variations on the flanks make correlations from well to well difficult even with the extremely close spacing normally used. Also, many of the early wells that produced from the Miocene were drilled before the days of electrical logging. This has increased the difficulty of detailed geological analysis in that portion of the section. Better information is available on the Oligocene to the depths of the regular producing sands and it has been possible to work out a complete type section.

Below the massive Miocene sands the Oligocene, to the bottom of the lowest sand that has been extensively developed, consists of about 1,500 ft. of shales, limes, sandy limes, and sands. Faults are so numerous, however, that the logs of several wells are required to make a complete composite section. Three limes, each 100 ft. or more in thickness, can be identified. The uppermost is the Heterostegina lime and the other two occur just below the first appearance of *Marginulina iddiomorpha.*

The productive sands occur in the bottom 500 ft. of the type section and

THE AUTHOR

Donald D. Utterback is district geologist and engineer, southeastern district, for the oil and gas division of Freeport Sulphur Co. He received his Ph.D. in geology from University of Illinois in 1936, and since 1938 his work has been concentrated on the South Louisiana Gulf Coast and South Louisiana salt domes. In 1946, shortly after his return from World War II, he joined Houston Oil Co. to organize its South Louisiana district.

consist of three separate major reservoirs plus several thinner minor sand streaks. The upper and middle sands are each 30 to 40 ft. in thickness with minor shale breaks and an occasional hard lime streak. They will each average 15 to 25 ft. of effective sand. The lower sand is usually a broken section about 100 ft. in over-all thickness. Individual sand or shale members cannot be correlated from well to well. Similarity of oil gravities and gas-oil ratios plus the presence of only one water level where the oil-water content has been penetrated identifies this broken section as one reservoir. Net effective productive sand ranges from 50 to 75 ft.

Deeper Frio sands have not been productive at the locations where they have been penetrated on the west flank. On the southeast flank some production has been obtained from sands below the regular producing horizons. These were not of sufficient value to merit extensive development on that portion of the dome.

Production Characteristics

Accumulation in both the Miocene and Oligocene is found near the sand pinchout and does not usually extend far enough out to allow for additional locations down dip. At this position in relation to the dome the sands are turned up steeply with dips ususally in excess of 45°. A short distance under the Oligocene producing zones the wells usually encounter high pressures that are associated with material that resembles a shale sheath. These pressures are a constant source of danger in drilling for the Oligocene sands.

In the highly faulted flank sediments small drainage areas and closed reservoirs are frequent. As a consequence, the results of drilling and the amount of recovery have been unpredictable from location to location. One Miocene well produced over 1,000,000 bbl. of oil before being abandoned. Others have produced only a few thousand barrels. Of three Oligocene wells 500 ft. apart on a north-south line, the north one came in with 1,400 psi. flowing pressure and declined 400 psi. in 9 months where it leveled off making about 50 bbl. per day. The flowing pressure on the middle well declined in a few days so that the well had to be pumped. The third well came in at 1,500 psi. flowing pressure and has produced for 6 months with a pressure decline of only a few pounds. These three wells were completed in the same sand within a few feet of the same depth.

Water drive . . . The presence or absence of a water drive is largely controlled by the fault system in the vicinity of the individual well. Due, probably, to the greater amount of sands in the Miocene and the consequent greater probability of intercommunication between sands, many Miocene wells have had effective water drives. The situation is reversed in the Oligocene where a completely effective water drive is rare and most wells have shown either a limited water drive or none at all.

As could be expected in the numerous individual fault segments, oil gravity and gas-oil ratios are not consistent. The Miocene oils usually have gravities between 25° and 30°. Gas-oil ratios vary from 100 to 1 to 500 to 1. In the Oligocene both gravities and ratios are somewhat higher. Gravities will range between 35° and 40° and ratios between 400 to 1 and 800 to 1. The most consistent characteristic is that the oils are undersaturated. For this reason gas caps are rare unless production has reduced the reservoir pressure to below the bubble point. Only three wells have reported high ratios upon initial completion.

Recent Developments

In November 1950 Freeport Sulphur Co. acquired the oil and gas lease on a large portion of the dome. This lease covers the shallow caprock area and is limited to shallow Miocene productive depths on the east and north. On the west it includes the large overhang and depth possibilities to the regular productive Oligocene sands. To the northwest, southwest, south, and southeast it extends far enough out from the dome to be prospective for lower Oligocene sands. The first well was drilled on the northeast flank and was completed in February 1951 as a producer from a Miocene sand at 5,355-5,440 ft. The second well was completed May 2, 1951, as a Miocene producer from a thick section of saturation under the overhang on the west flank at 5,440-5,562 ft. The third well was on the northwest flank. It drilled to salt at 9,032 ft. and was plugged back for completion in an Oligocene sand at 7,932-62 ft. It was completed January 1, 1952.

By the time the third well was completed the first two had begun making water. The third well came in with a flowing pressure of 1,400 psi. and declined to 400 psi. in a few months. These developments were not unusual. They are in line with the past production history of the dome which has been featured by high development costs and erratic production behavior of individual wells.

In May 1952 Freeport decided to start on an extensive development program. This decision was largely the result of a conviction that important reserves remained that, by improvements in geological and engineering control, could be developed and produced at substantial decreases in per well cost and substantial increases in per well return. Continued development of the Oligocene production on the west-northwest flank was the first objective. Development was to continue from well to well in areas of known possibilities where the maximum amount of control was available. Exploration for new producing horizons or in new areas was to be attempted only when necessary or where accumulated information and control proved it especially favorable.

Geological control . . . Closer control of all locations was the first objective. This is achieved by carrying one or more tentative locations in advance of drilling. These are subject to continuous study and change as additional information becomes available. Final location for the next well is not decided upon until geological information is complete on the preceding well. The objective of each well is to find the productive sand at the highest structural position where adequate development is also present. The probable amount and direction of drift of the hole as indicated by preceding wells is taken into account in making each location. An arbitrary spacing of 500 ft. is used between wells on strike. Wider spacing is not used because of the probability of bypassing some fault segments. Closer spacing tends to restrict each well's drainage area to unprofitable limits. Spacing on dip is usually closer and is determined entirely by the position at which additional sands can be encountered that are not present in updip wells.

Close geological control of each well during drilling to avoid unnecessary trouble and expense is another prime objective. Rate-of-penetration records are kept and correlated with offset wells. Key horizons are identified in the final 1,000 to 1,500 ft. of hole and for the final 500 ft. the geologist is at the well correlating drilling time with sample lithology. It is the geologist's responsibility to carry the well through the known objective sands and to stop it before the high pressures of the shale sheath are reached. Unless good reason exists for suspecting possible shallow accumulation behind the surface pipe, electrical log is not run until the well has reached the depth at which the long string of pipe is to be set.

Correct evaluation of the objective sands is, of course, of extreme importance. This is accomplished by conventional electric log and thorough field analysis of side-wall cores. Auxiliary services have been used where they are considered especially desirable. As a matter of economy, however, it is the geologist's responsibility to correctly

appraise the sands by thorough coring following the electrical log without reference to other types of information.

Drilling

Drilling is all done by contract. The footage rate paid for contracts between 8,000 and 8,500 ft. has varied from $4.50 to $5.25 per foot. The normal casing program consists of 16-in. conductor pipe set at about 100 ft.; 10¾-in. surface pipe set at about 1,700 ft. and cemented to the surface; and 5½-in. production string set on bottom and cemented with 300 to 500 sacks. Scratchers and centralizers are used on the bottom portion of the oil string to insure a good cement job. If exploration is to be carried on below the regular producing Oligocene sands, 7-in. casing is set and 6⅛-in. hole drilled on down. This is necessary because abnormal pressures are encountered in the lower horizons as well as in the shale sheath.

Some trouble has been experienced with failure of the bottom joint of the 10¾-in. surface casing. In Freeport's third well the bottom joint broke off and dropped down the hole. It was eventually necessary to sidetrack the hole around the joint. In subsequent wells the pipe was bottomed in a sand and 50 sacks of neat cement spotted on bottom. Since then no major trouble has developed although it has been suspected that the bottom joint has parted in two subsequent wells.

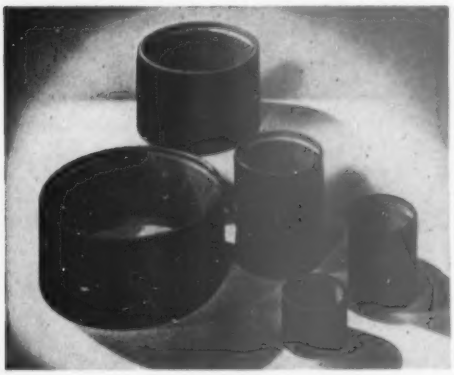
Hole deviation . . . In the steeply dipping flank sediments excessive deviation of the hole from vertical is a major difficulty. This is one of the reasons for the past expensive drilling and development on the dome. In general, the upper portion of the hole can be kept within reasonable limits by several drill collars and light weight on the bit. Under these conditions the average well on the west flank has drifted out and to the north until below 7,000 ft. when the hole tends to turn back towards the dome. Advantage has been taken of this characteristic by intentionally carrying enough weight on the bit towards the bottom to increase the deviation to between 2° and 3°. This allows for faster drilling in the hard limes of the lower section and at the same time swings the bottom of the hole in towards the dome, compensating for the outward drift in the upper portion and bringing the bottom of the hole back to the limited desirable position of the original location.

Drilling-mud control is relatively simple unless the high-pressure horizons of the lower Oligocene or the Oligocene shale sheath are to be drilled. Mud weights of 10.1 to 10.5 lb. per gallon have been adequate. Caustic and tannates are largely used for thinning purposes and commercial jel for water-loss control. Only a small amount of weighting material is necessary unless weights of over 10.5 lb. per gallon are required.

Completion procedures have been kept as economical as possible. In the Oligocene, squeeze cementing is not necessary for the original completion. Geological evaluation of the various sands has been reliable enough that drill-stem testing has not been necessary. Pressure decline and not possible water encroachment is the chief problem in the Oligocene sands with steep dips and limited water drive. For this reason the policy has been adopted of opening up each reservoir to the maximum extent, even perforating through shale partings for possible thin sand streaks. The individual pay section is completely perforated with four shots per foot, tubing is run on packer, and the well washed in. At times it has been necessary to run a swab once or twice before the well would flow. After a short period of cleaning, it is turned into the tanks.

Production

Production practices are closely controlled. Recording pressure gages are used on all new wells and on any well



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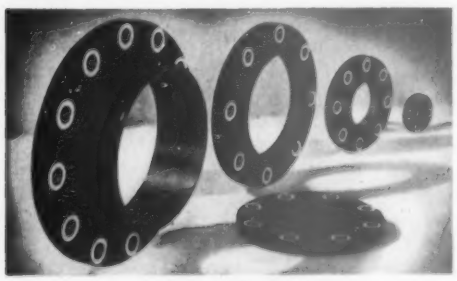

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showing unusual pressure characteristics. Solution gas-oil ratios, bubble-point pressures, and bottom-hole pressures are estimated to within satisfactory operating limits from each well's behavior. Daily rate of production is controlled on each well with a view to prolonging the flowing life and obtaining maximum recovery. Even with the close spacing used, offset wells rarely have comparable producing characteristics and each well must be controlled according to its individual requirements.

As a well begins to make water the volume of fluid production is increased as much as possible without over producing the well's oil allowable. Gas lift is used in the later stages of productive life and, although the situation has not yet been encountered, it is planned to produce wells making water to as little as 2 per cent oil. Salt-water disposal is taken care of by injection into shallow salt water sands. The one salt-water-disposal well now in use takes all the water from two wells with no well-head pressure.

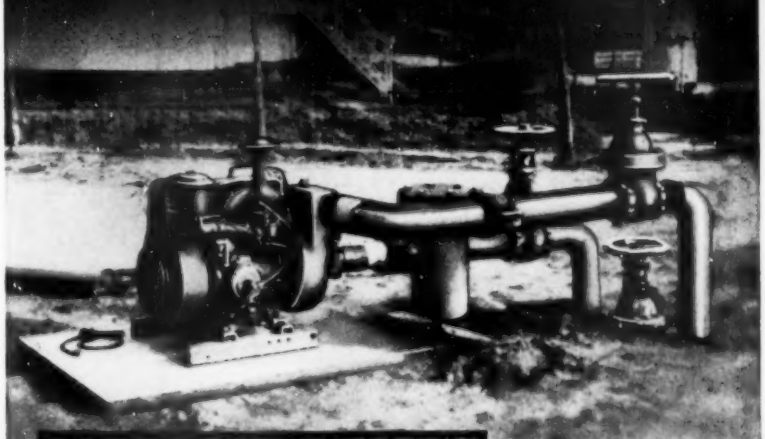
All three operators on the dome have been engaged in active development during the past 2 years. In addition to Freeport's activities three producers have been completed on the east flank and seven on the north, northwest, and west flanks. The problems encountered by each operator are essentially the same. The methods of meeting these problems may vary considerably according to the policy of each organization.

The results of Freeport's program have thus far been highly successful. Wells have been drilled at locations for which little improvement could be desired. A minimum amount of expense has been incurred in unproductive deeper exploration below primary objective sands. Wells have been stopped before high pressures caused trouble and added to the expense. Service operations and rig time have been reduced to a minimum. As a result, the average cost of completed producing wells has been reduced by over 25 per cent. Close control of production practices has benefited weak wells and kept them producing at their maximum capacity. Of the last five wells completed only one is deficient. The other four show no sign of serious pressure decline and give every indication of a long flowing life. In addition, three of the four strong wells have good sands behind the casing to be produced when the present completion is depleted.

Acknowledgment

The author wishes to express his appreciation to Freeport Sulphur Co. for permission to publish this article.

ACTION *proves*



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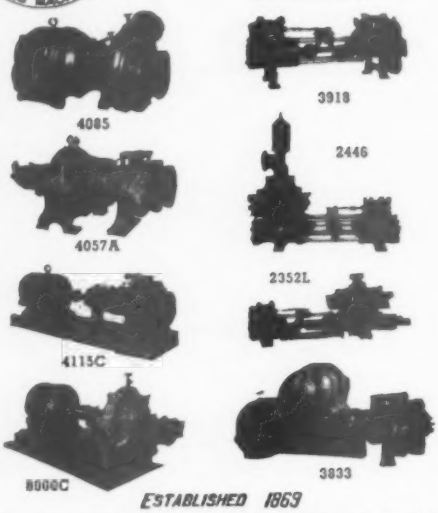

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HOW CYCLING WORKS . . .

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The Gulf Coast area holds the majority of the nation's 48 cycling plants. 33 in Texas, 8 in Louisiana, and 1 in Mississippi

by Judson S. Swearingen*

MAXIMUM recovery of rich reservoir gas by cycling the residue gas continues to be a subject of considerable interest, and efforts are being made to develop more accurate methods for predicting recovery.

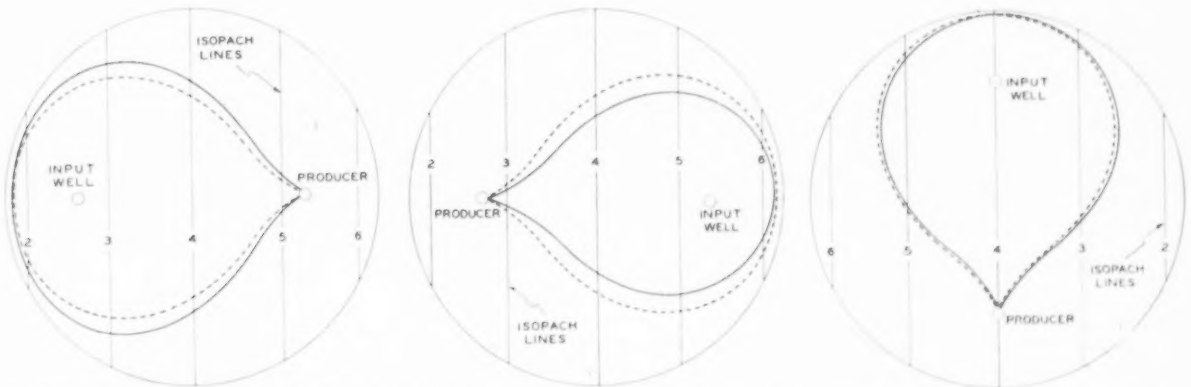
On the other hand most of these answers can and have been obtained empirically using laboratory electrolytic models. Results from models have been of great value, per se, and are also of value in giving moderately accurate answers to the problems it is proposed to solve more accurately by analytical means utilizing calculating devices.

By means of models, previews of answers with an accuracy of a few per cent may be seen showing effects of thickness, displacement effectiveness, permeability variations, faults, crevices, and the like. Qualitative estimates of these effects are frequently of value in cases where time is not taken or is not available for making a model study. Hence, a "feel" of the problem is desirable and a presentation of it constitutes the purpose of this paper. This purpose can be accomplished by simple illustrations. The effects of variable thickness and variable permeability are used for the illustrations. Effects of crevices and faults are currently being studied by another laboratory and will presumably be published later.

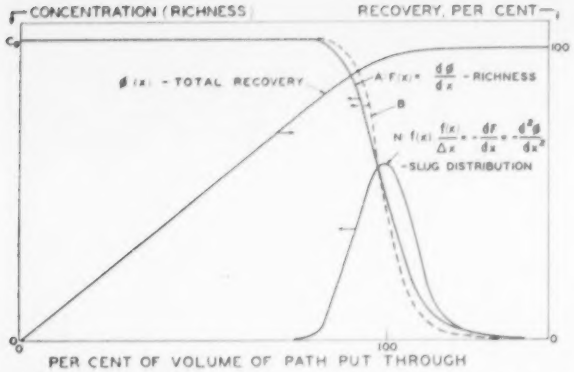
*Director, petroleum division, Southwest Research Institute, San Antonio.

Thickness Vs. Displacement Pattern

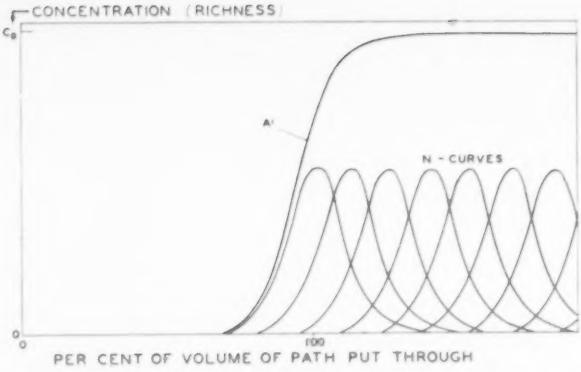
Three extreme cases are shown to indicate the effect of variable thickness.



CYCLING DISPLACEMENT PATTERNS for injection wells. FIG. 1, at left, is for injection well in thinner section; FIG. 2, center, is for injection well in thicker section; FIG. 3, at right, is for input and producing wells symmetrically placed with respect to thickness variations. Dashed line patterns would result if thicknesses were uniform.



CYCLING RELATIONS for total recovery, richness, and slug distribution. Fig. 4.



CYCLING RELATIONS for richness at outlet and concentration of injected material. Curve A' is sum of the N curves. Fig. 5.

Figs. 1, 2, and 3 involve identical fields, the thickness of which varies uniformly from one edge to the other, as shown by the isopach lines. In each case the shape of the pattern that would result from a similarly shaped field of uniform thickness is indicated by a dashed line. Figs. 1 and 2 differ only in the respect that the injection and producing wells are interchanged. Though the displaced areas are different, their recoveries (volumes) are equal.

Fig. 3 shows the same field as Figs. 1 and 2 with the sole difference that the two wells are on the same isopach line. This is at right angles to the orientation in the first two figures. In all three the recovery is about the same.

The experimental "dry gas" pattern with the thickness taken into account along with the displaced area gives the displacement that is possible before dry gas reaches the producing well (or wells) with the particular field and well locations.

The error caused by assuming the thickness to be uniform is represented by the space between the solid and the dashed-line figures. In some cases this may be small in comparison with uncertainties as to the thickness and extent of the field.

In Figs. 1, 2, and 3 the dry gas has reached the producing well by the straight and most direct path only, but it will soon have arrived by the longer curved paths, so the producing well would be expected to go dry rather rapidly, and especially rapidly if there are other producing wells behind it.

Displacement Effectiveness

The above analysis presupposes a sharp boundary line between wet and dry gas and complete displacement of one by the other. In some commercial operations displacement of wet gas by dry gas has been found quite effective.

The laboratory analysis of displacement was made of a one-dimensional path, specifically a sand-packed tube where water was used instead of gas.

A tube, 1.3 cm. in diameter and 50 cm. in length, was packed with 30-40 mesh sand and the voids filled with dilute sodium chloride solution. The solution was then displaced with distilled water as samples were taken for chloride determination and in this way the curve of richness at the outlet end versus volume put through was plotted. If displacement were perfect, the salt concentration would drop instantly from the constant value to zero when the pure water reached the end of the tube. Actually the data shown by Curve A in Fig. 4 were obtained. About 95 per cent of the chloride solution was displaced by the time an amount of water equivalent to the volume of the voids was injected.

The problem was studied in a somewhat different manner. A thin "slug" of salt solution was sent through the sand-packed tube filled with pure water. Again, perfect displacement of one liquid by the other would mean the sudden appearance of salt solution and as sudden a disappearance of the salt solution. Actually Curve N, Fig. 4, was obtained. That is, a thin slug of liquid on passing through this particular sand bed was spread out in the direction of flow as shown by this curve.

Any continuous column of fluid entering the sand tube may be considered to be made up of a succession of thin slugs of fluid, each of which slugs behaves like the thin slug of salt water in the last experiment, and hence each slug on passing through the sand bed will be distributed over anterior and posterior portions just like this salt plug was.

In the experiment first described where the salt solution was displaced by pure water, the water may be considered as being made up of a succession of thin slugs or increments of water wherein each slug of water is distributed through the portions preceding the following in exactly the same manner as shown for the salt by Curve N, Fig. 4. Then Curve A', Fig. 5, is the sum of all of this series of N-curves. Curve A, Fig. 4, is the richness curve for the salt solution and Curve A', Fig. 5, is the displacement curve and refers especially to the water. Curve A' is the plot of the function F'(x) and Curve A is that of F(x). Their relation is:

$$F'(x) = C_o - F(x)$$

Their slopes are opposite in sign.

Let us designate the first of this series of N-curves by f(x). The next curve will be $f(x - \Delta x)$ and so on, and Curve A', Fig. 5, which is the sum of these N-curves is:

$$F'(x) = f(x) + (x - \Delta x) + (x - 2\Delta x) + \ldots$$

The differential of F'(x) with respect to x may be obtained as follows:

$$F'(x) - F'(x - \Delta x) = [f(x) + f(x - \Delta x) + f(x - 2\Delta x) + \ldots] - [f(x - \Delta x) + f(x - 2\Delta x) + \ldots]$$

$$\frac{\Delta F'(x)}{\Delta x} = \frac{f(x)}{\Delta x}$$

or

$$\frac{dF'}{dx} = \frac{f(x)}{\Delta x}, \text{ as } \Delta x \to 0$$

and

$$\frac{dF}{dx} = \frac{-f(x)}{\Delta x}, \text{ as } \Delta x \to 0$$

F(x) is the derivative of the total production curve $-f(x)/\Delta x$ is the second derivative of the production curve. Curve A', Fig. 5, could be obtained

more accurately by graphically integrating Curve f(x)/Δx, Fig. 4. Subtraction of A′ from the original concentration, C_o, gives the Curve A, Fig. 4.

One use of this analysis lies in the calculation of the displacement or richness curve for passage through longer paths than this short tube.

At this point it is possible to see the significance of this experiment by examining the effect of passing the effluent from this sand-packed tube through another similar sand-packed tube. This constitutes a total path of double the length of the first. The significant point is that the distribution of the slug upon emerging from the second path is not twice as great as it was from the first, and therefore in percentage, the scattering is less. Curve B, Fig. 4, shows this percentage distribution from the longer path in the form of the production-richness curve.

This may be proved as follows:

An increment or slug of liquid upon passing through the first tube is spread out according to f(x). It is evident that each increment or slug of this f(x) upon being passed through the second tube is also spread out according to f(x) so that $f_2(x)$, the concentration at the end of the second tube, versus x, the volume passed, is the sum of this series of curves:

$$f_2(x) = C_2 \int_0^\infty f(x_1) \times f(x - x_1 + c)\, dx_1$$

This is capable of rather simple graphical solution. It gives the differential of this final displacement curve at the end of the second tube. The length of this tube can again be increased by evaluation of:

$$f_3(x) = C_3 \int_0^\infty f(x_1) \times f_2(x - x_1 + c_2)\, dx_1$$

or doubled by the evaluation of:

$$f_4(x) = C_4 \int_0^\infty f_2(x_1) \times f_2(x - x_1 + c_4)\, dx_1$$

In this manner the slug distribution may be obtained for a path of any multiple length of the original test path, and by dividing by Δx, the slug thickness, and integrating any richness curve obtained.

If Curves A and B had been plotted on the same volume scale, Curve B would actually be somewhat flatter than A. However, in order to compare the mixing on the basis of the total length, appropriate shortening of the x-scale was made for Curve B. By integrating Curve B, Fig. 4, it may be shown that 96.3 per cent of the chloride solution was displaced from the double-length tube by the time an amount of water equivalent to the volume of the voids was injected. For the short tube 95.5 per cent was thus obtained. It is evident that mixing at any considerable distance is of diminishing importance.

It has been suggested that a very permeable layer through the middle of the producing horizon would allow the dry gas to go quickly from the injection well to the producing well and practically dry it up, while the great percentage of rich gas still lies in the less permeable layers.

The important and underestimated factor in flow through sand is the component of the flow at right angles to the direction of the flow (mixing) even though the flow of the fluid through the sand is viscous. This transverse movement is recognized only for turbulent flow through conduits.

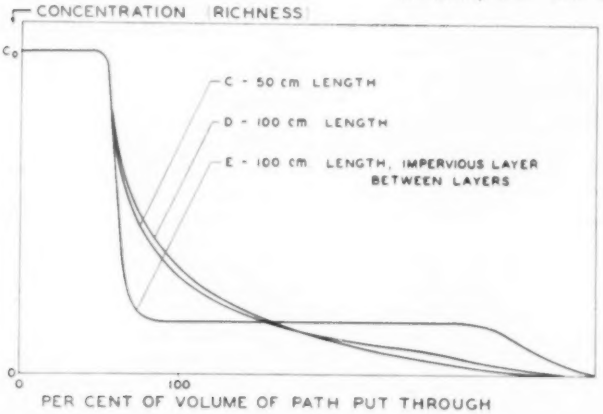
Two layers of sand of different permeability in contact would exchange contents by this transverse movement or exchange of fluid so that the rich contents of the tight sand would move out into the stream of faster moving fluid in the loose sand and be carried away to be exchanged for still richer material, etc. The result is that the displacement is somewhat the same as though the whole mass of sand were of uniform permeability. The actual result with a 1.3-cm. tube, 50 cm. long containing two parallel layers of sand with a relative permeability of 5.2 is shown by Curve C, Fig. 6. The same analysis may be applied to this tube as was applied previously to the uniform sand. The displacing fluid may be regarded as being introduced in increments and each increment on passing through the tube is distributed according to the negative differential of Curve C, Fig. 6.

The experimental result using a continuous double layer tube similar to the first but twice its length is shown by Curve D, Fig. 6.

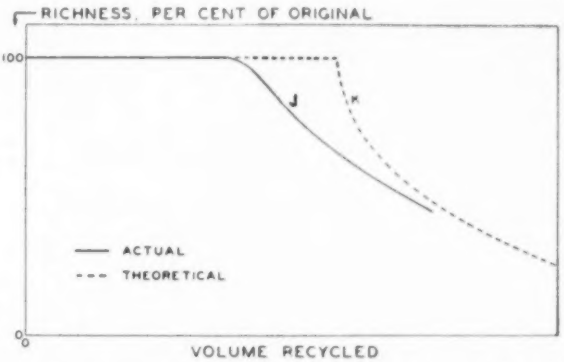
These experiments were carried out at flow rates high enough to prevent the results being influenced to more than a minor extent by diffusion. This was proved by the fact that the flow rates had to be reduced (time increased) by a factor of 10 to obtain a curve similar to D from a tube half as long.

The result for a path of any length may be calculated by a method similar to that used for the homogeneous sand. By symmetry the 50-cm. tube is approximately equivalent to two 10-ft. layers 900 ft. long. The equivalent is not exact because the tube was not rectangular.

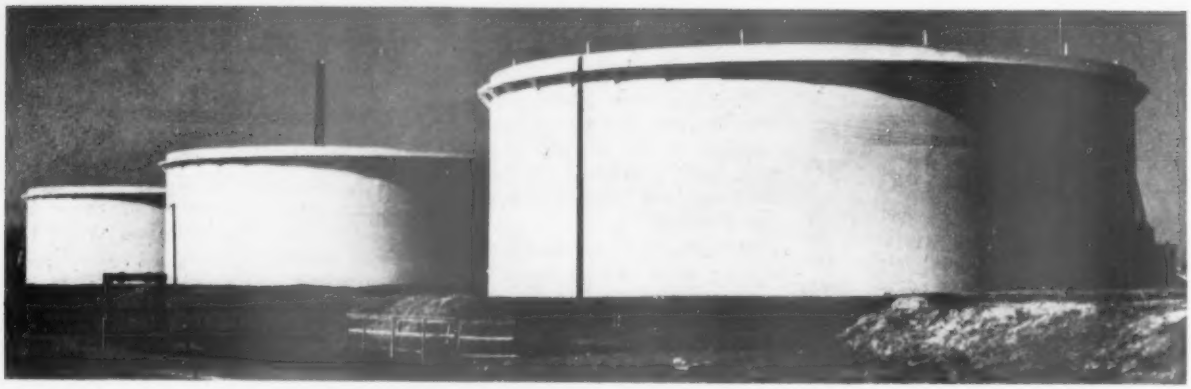
In Fig. 7, Curve K represents the richness curve estimated from the electrolytic model where perfect displacement was assumed. However, the theoretical recovery, represented by the area under Curve K, exceeds by 10 or 20 per cent the field recoveries being obtained. These results are explainable by the above theories. Thus, a reasonably accurate estimate of the recoverable reserve of wet gas may be made by the application of the electrolytic model and a factor usually between 0.8 and unity which varies with well positions and the uniformity of sand permeability.


CONCENTRATION (RICHNESS)
C_o
C - 50 cm LENGTH
D - 100 cm LENGTH
E - 100 cm LENGTH, IMPERVIOUS LAYER BETWEEN LAYERS
0
100
PER CENT OF VOLUME OF PATH PUT THROUGH

DISPLACEMENT CURVES for paths of high permeability and low permeability in contact. Fig. 6.



TYPICAL CYCLING RESULTS as compared with results obtained from electrolytic models. Fig. 7.



EVAPORATION LOSSES have been reduced in these double-deck, floating-roof tanks at Humble's Baytown refinery by painting them white.

Paint double-deck, floating-roof tanks white to . . .

Reduce Evaporation During Storage

. . . Tests on Gulf Coast Demonstrate Its Utility

by Otto Gerbes

WHY THIS STUDY . . .

A number of articles have been written on the subject of evaporation losses from hydrocarbon storage. In general, losses are presented as some function of tank throughput or size but seldom is there any presentation of actual data. This absence of data is more pronounced for floating-roof tanks than for cone-roof tanks. Correspondingly, there are fewer data on double-deck floating-roof tanks than on the pan and pontoon types. To extend the deficiency, there are fewer data and less general information on storage of natural gasoline compared with motor fuel.

The data presented herein, which were obtained on standing storage tests involving natural gasoline stored in a double-deck floating-roof tank, fill a small part of this void and are expected to be of use to the industry. Interest in the use of white paint to reduce gasoline evaporation losses (from cone-roof tanks) has quite recently been revived by the studies reported by Smith and Harden[1]. At least as far back as 1937, economies of use of white paint on floating-roof tanks were reported. Albright[2] reported that gasoline savings attributable to use of white paint were balanced by the over-all higher costs of white paint giving a breakdown operation on an 80,000-bbl. floating-roof tank. As pointed out, this resulted from the fact that losses with aluminum paint (in the motor-fuel range of R.v.p.) are normally quite low.

Data are presented herein demonstrating that at Gulf Coast conditions, use of white paint on a double-deck floating-roof tank pervents boiling of 13.3-psi. R.v.p. natural gasoline with its attendant high loss rate and in addition permits storage of 16-psi. R.v.p. natural gasoline without high loss. This increased utility for low-pressure storage represents a large return on the incremental cost of the white paint where the operator is confronted with the alternatives of purchasing the relatively more expensive pressure-type storage such as a spheroid or of taking a high loss in the summer. Additional data are presented such as pertinent temperature measurements which are expected to be of value to technical personnel.

NATURAL gasoline of 13.3 psi. R.v.p. should not be stored in an aluminum-painted tank at temperatures above 90° F., since boiling occurs between the seal ring and the tank shell, causing a high loss rate. Higher storage temperatures can be used without excessive loss when the tank is painted white.

Natural gasoline of 16 psi. R.v.p. can be stored in an all-white tank without boiling losses at a main body temperature of 86° F.

A statistical correlation of shell temperature at the seal-ring level versus time of year will permit a fairly accurate prediction of the maximum vapor-pressure stock that can be stored without high loss rate (due to boiling) at any time of the year. It will have utility in maximizing the vapor pressure of stocks stored in the fall for use in the winter grades of motor fuel.

The utility of white paint in permitting the storage of higher R.v.p. stocks is equivalent to obtaining an effective higher safe working pressure on a vessel without having to increase the metal thickness. It thereby extends the range of R.v.p. of product which can be stored in a double-deck floating-roof tank before the processor must switch to the relatively more expensive pressure-type storage.

Test opportunity . . . One of the handicaps of determining losses of hydrocarbons from storage is that it is seldom possible to segregate storage, free from movements, for any length of time. However, such an opportunity presented itself at the Baytown refinery of Humble Oil & Refining Co. in the summer of 1948, when 13.3-psi. R.v.p. natural gasoline was seasonally stored for winter use in a new 140,000-bbl., single-seal, double-deck floating-roof tank which had just been constructed.

Upon completion of the tank, circumstances required that it be placed in operation although it had not yet been painted. A test of 4 months' duration was conducted, August through November 1948, in which more than 130,000 bbl. of 13.3 R.v.p. natural gasoline was held in dead storage. A loss of 24 bbl. per day, as measured by decrease of inventory, was incurred August 4-27, with the tank having received no paint until August 13, at which time the red, prime coat was applied. The red paint produced no observable reduction in loss rate.

This period was terminated by a

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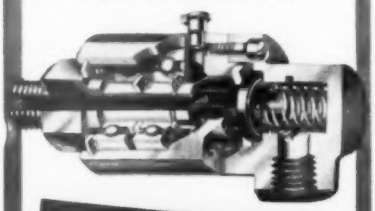

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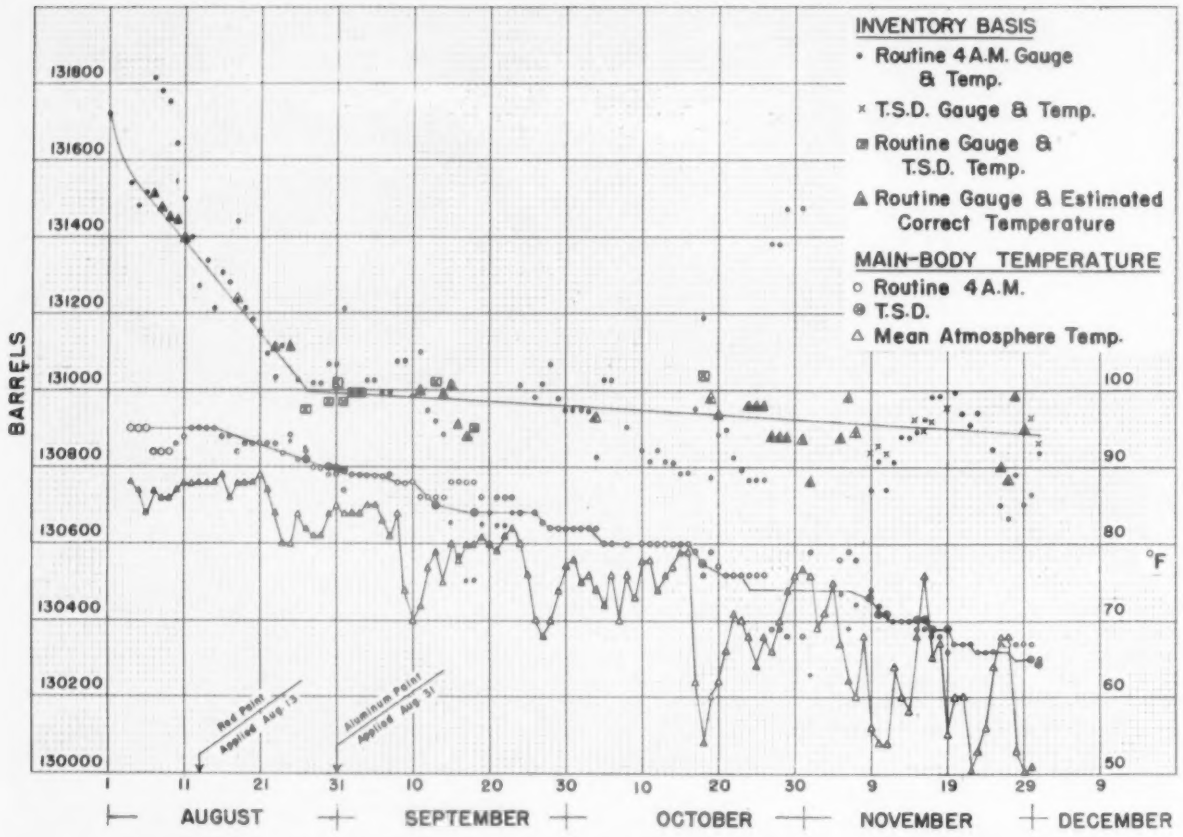


TEMPERATURE AND INVENTORY test on floating-roof tank, made at Baytown refinery in 1948. Fig. 1.

rather abrupt decrease in loss rate to 1-2 bbl. per day over-all average for the remainder of the test, August 28 to December 1. Aluminum paint was applied August 31; however, the fall seasonal decline in mean atmospheric temperature had already started and the main body tank temperature had dropped from 95° F. to 90° F., apparently having crossed a break-point temperature with respect to rapid loss of inventory. Thermocouple measurements indicated that the surface of the gasoline in the seal zone was at the boiling temperature (100° F.) a portion of the day until about September 3; thereafter, the gasoline failed to attain the boiling temperature.

It was concluded that the initial high loss rate was caused by boiling of the gasoline between the seal ring and the tank shell. Subsequently, evaporation could proceed only at the 1-2-bbl. per day rate induced by convection currents in a partial pressure of air. It seemed apparent that at temperatures above 90° F., 13.3-R.p.v. natural gasoline should not be stored in an aluminum-painted floating-roof tank. This conclusion was borne out by similar losses in July-August of the following year.

High loss . . . Since the high loss rate from the aluminum-painted tank was indicated to be caused by boiling, it was suggested that application of white paint to the tank might reduce the temperature below the boiling point. In order to test this suggestion, two 20-ft.-wide vertical stripes of white paint (separated by one 20-ft.-wide vertical stripe of existing aluminum paint) were applied on the outside face of the shell on the east side of the tank in August 1949. About the same inventory of similar natural gasoline was stored in the tank. Surface temperatures of the shell were measured with a portable pyrometer. The boiling temperature of the gasoline was indicated to be approximately 103° F.

The gasoline surface behind the aluminum-painted shell was at the boiling temperature from about 9:30 a.m. until some undetermined time in the afternoon whereas the gasoline behind the white-painted shell did not attain the boiling temperature at any time during the period when the sun was shining on the white surface. Boiling was easily observed by visual inspection after manually pulling the seal ring away from the shell. Vapor evolved could also be plainly detected both by sight and sound without disturbing the seal ring. For reasons explained subsequently, it was decided to apply white paint to the roof as well as the shell to prevent boiling of 13.3-R.v.p. gasoline in July-August.

In the spring of 1950 the tank shell and roof were painted white and a comparable inventory of similar natural gasoline was held in standing storage as long as possible. Within the accuracy of gaging over a 40-day period, starting July 28, 1950, there was no measurable loss of inventory. The difference between this negligible loss over a 40-day period with white paint and a loss of 560 bbl. over a 23-day period in August 4-27, 1948, is rigorously the benefit of white paint over red paint; however, qualitatively the white paint stopped the boiling of the gasoline whereas the aluminum paint did not. At no time was it possible to detect boiling by visual inspection as was possible the year before with the aluminum-painted tank. The temperature of the gasoline in the white tank in August 1950 was about 7° F. cooler than the temperature in the aluminum-painted tank under similar atmospheric conditions of August 1949.

Gasoline volatility . . . In view of the reduced tank temperature and loss rate from the all-white tank, it appeared

logical that significantly higher than 13.3-R.v.p. natural gasoline could be stored without boiling. In September 1951 it was necessary to prepare a 16-psi. R.v.p. blend and it was decided to make this blend in the floating-roof tank with careful observation of the results. Accordingly, natural gasoline in the all-white tank was blended to 16-psi. R.v.p. with normal butane at a main body temperature of 86° F. during and following the blend.

Over a period of days there were no visible signs of boiling or vapor evolution. Although it was not possible to retain this 16-psi. R.v.p. blend for loss measurements, it was believed the loss rate would be reasonably low even in July and August since boiling would not occur. Thus, the most important benefit of white paint is that it permits storage of materials having a significantly higher R.v.p. in a floating-roof tank at a given set of conditions.

THE AUTHOR

Otto Gerbes joined Humble Oil & Refining Co. in 1939, in the Baytown Technical Service Division. His responsibilities have covered the fields of crude distillation, light-ends recovery and fractionation, thermal and hot-acid polymerization, isomerization, and alkylation. Recently he served on the A.P.I. Evaporation Loss Committee for Cone-Roof Tanks, and at one time was a member of the A.G.A.C. Isomerization Subcommitte and chairman of the PRC District 3 Isomerization Subcommittee. He was born in San Antonio, and is a graduate of University of Texas, with an M.S. in chemical engineering.

Description of Experimental Condition

1. Standing Storage Test (Nonwhite Tank)—1948

All tank lines were blinded and the tank shell and roof were painted as indicated in Fig. 1. Inventories at 60° F. were based on hand gages with a steel tape; corrections were made for water and roof displacement, and for temperature using NBS Circular C-410. Temperatures were measured with an open-cup thermometer which introduced some errors in the routine measurements due to partial evaporation of the natural gasoline. A closed-cup thermometer should have been used since a deviation of ±0.5° F. represents ±50 bbl. A deviation of ±⅛-in. gage represents ±30 bbl.

It was anticipated that a long period of time would be required to demonstrate a significant change of inventory in the 145-ft.-diameter tank. The unexpected initial high loss rate revealed by the reasonably accurate initial routine measurements occurred before special measurements were made by technical personnel. Opening and closing inventories were used to determine the over-all losses for both the high and the subsequent low loss periods. Intermediate routine measurements were used merely to insure against possible error in the terminal measurements.

The composition of the natural gasoline was as follows:

°A.P.I.	81
R.v.p. at 100° F.	13.3
n-Butane, mol per cent	5.55
i-Pentane, mol per cent	26.40
n-Pentane, mol per cent	26.35
Heavier, mol per cent	41.7
Heavier, sp. gr.	0.711
Mol weight	91
mm. Hg V. P. at 100° F.	240

2. Comparative Temperature Measurements on White and Aluminum-Painted Portions of Tank Shell—1949

To determine the utility of white paint as a means of eliminating the boiling, the aluminum-painted tank was given two 20-ft.-wide vertical stripes of white paint (separated by one 20-ft.-wide vertical stripe of existing aluminum paint) on the outside face of the shell on the east side of the tank. The white paint was 2 weeks old and the aluminum paint was nearly 1 year old at the time of the test. Natural gasoline similar to that used in the 1948 test was stored in the tank. Surface temperatures of the shell were measured with a portable contact pyrometer at the level of the surface of the gasoline between the shell and the seal ring.

3. Standing Storage Test (All-White Tank)—1950

The tank shell and roof were painted white several months prior to the start of another dead-storage test. An inventory of 130,473 bbl. of the 13.3-R.v.p. natural gasoline was accumulated in the tank for the test. Weather conditions in August 1950 were similar to those of August 1948. It was not considered necessary to duplicate the numerous temperature measurements of the 1948 test, particularly in view of the cost of removing the tank from service to permit installation of new thermocouples.

4. Blending Test (16 R.v.p. in All-White Tank)—1951

Natural gasoline of about the same composition as that used in the 1948 test was blended by recirculation with n-butane addition to an R.v.p. of 16 psi. in the all-white tank. Determination of boiling was to be made by visual observation. Maximum, minimum, and average atmospheric temperatures on the days during and immediately following the blend, which was made September 10, were the same as the corresponding 31-day averages of a typical August on the Gulf Coast.

TABLE 1—PERTINENT INVENTORY DATA (STANDING STORAGE TEST—1948)

Date, 6 a.m., 1948—	Inv.* at 60° F., bbl.	Main body tank temp., °F. (Hg Therm.)	Indicated average loss per period, bbl. per day	Remarks
August 4	131,560	95		No paint on tank
August 13	131,340	95	24.4	Applied red prime coat
August 27	131,000	91	23.6	Red paint only
August 31	131,000	89		Applied aluminum paint
December 1	130,860	65	1.5	Aug. 27-Dec. 1 covered 96 days

*Corrected for temperature using NBS Circular C 410 and for water and roof displacement.

TABLE 2—CRITICAL SEAL-ZONE TEMPERATURES (STANDING STORAGE TEST—1948)

Date—	Time	Relative temp. between pontoon and seal ring °F.,* liquid surface	Main body temp., °F.	Seal zone liq. surface temp. relative to boiling temp. (100° F.)
August 30	7:45 a.m.	89	89	Below boiling
	1:15 p.m.	100	90	At boiling
	4:00 p.m.	98		Below boiling
August 31	9:15 a.m.	89	89	Below boiling
	11:40 a.m.	95	90	Below boiling
	1:15 p.m.	100	90	At boiling
	2:20 p.m.	100	90	At boiling
September 1-2		About same as August 31		
September 3	1:15 p.m.	98	89	Below boiling
September 13	2:00 p.m.	90	85	Below boiling

*Iron-constantan thermocouples with 0°-300° F. indicator.

TABLE 3—FLOATING-ROOF-TANK TEMPERATURES, °F. (STANDING STORAGE TEST—1948)

Thermocouple location and number—	Aug. 30 7:45 a.m.	Aug. 30 1:15 p.m.	Aug. 30 4.00 p.m.	Aug. 31 9:15 a.m.	Aug. 31 11:40 a.m.	Aug. 31 1:15 p.m.	Aug. 31 2:20 p.m.	Aug. 31 2:40 p.m.	Sept. 3 9:00 a.m.	Sept. 3 1:15 p.m.	Sept. 13 2:00 p.m.	Dec. 1 1:15 p.m.
Seal zone top No. 6	86.5	100	99	88	97	102	102	101	87	101	91	71
Seal zone gas No. 5	88	100.5	98.5	89	97	102	102	102	87	100.5	90.5	71
Seal zone interface No. 4	89	99.5	98.5	89	95.5	102	102	102	89.5	98	90	71
Seal zone interface No. 3	89.5	98	97.5	88.5	93.5	100	100	100	89.5	97	89	69
Seal zone liq. No. 2	89.5	98	97.5	88.5	93.5	99	99	100	89.5	97	88.5	69
Seal zone liq. btm. No. 1	89.5	97	96.5	88	92.5	97	98	99	89.5	97	86	69
Roof top No. 9	86.5	125.5	104	117	140	144	140	135	108	137	120.5	98
Under roof top No. 10	88	121.5	105	105.5	129	134	132	128	100.5	130	111	81
Over roof bottom No. 8	87.5	115	104	98.5	115.5	123	122	121	94	119.5	105	83
Roof bottom No. 7	89.5	114	106.5	96.5	115	121	120	120	93	117.5	105	86
1 in. below btm. deck No. 15	90	104	103	89	101.5	106	106	106	88	105.5	96	82
3 in. below btm. deck No. 14	90	100.5	98	87.5	95	103	102	103	88	102	86	72
7 in. below btm. deck No. 13	90	89.5	90.5	87	90	90	90	93	88	89	85.5	70
12 in. below btm. deck No. 12	90	89.5	90	87.5	90	90	91	91	88	89	85.5	70
20 in. below btm. deck No. 11	89	89.5	87	87.5	91	90	90	91	83.5	83.5	85.5	68
Gage hatch*				89.5	89.8	90.5	90		89	89.5	85	64.5
Tank center*									89	89		64.5
Air temperature No. 16	77	93	82	84	94	100	97	100	83	96	88.5	72
Weather	Cloudy	Haze	Before rain	Clear	Clear	Clear	Clear	Clear	Clear	Sctd. clouds	Sctd. clouds	

*Open-cup thermometer—21 ft. below oil surface.

Tests Results

1. Standing Storage Test (Nonwhite Tank)—1948

Details of inventory, main body temperature, and mean atmospheric temperature are shown chronologically in Fig. 1. The net inventory changes are summarized in Table 1 where the indicated loss of 24 bbl. per day over the 23-day period, August 4-27, is realistically about 22-26 bbl. per day after allowing for gaging inaccuracy of about plus or minus 50 bbl. Similarly for the 96-day period, August 27-December 1, the indicated loss of 1.5 bbl. per day may be 1-2 bbl. per day.

Critical seal-zone temperatures are summarized in Table 2 wherein it is indicated that boiling took place a few hours per day to about September 2. This explains the high loss rate August 4-27. Seal-zone temperatures, after September 2, indicate boiling could not occur. Thus, evaporation could proceed only at the rate induced by convection currents in a partial pressure of air. This accounts for the low loss rate, August 27-December 1.

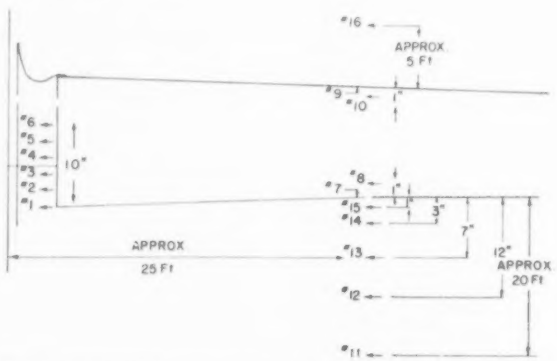
Referring to the miscellaneous temperature measurements shown in Table 3, the 96° F. temperature of the bottom cone-shaped deck on August 31 indicates the presence of a gas pocket under the roof as far out as 25 ft. from the circumference of the roof and as early as 9:15 a.m. As far as is known, no significant quantity of gas was lost

TABLE 4—COMPARATIVE METAL SURFACE TEMPERATURES
(1949 Measurements)

Time (Aug. 25, 1949)—	Relative shell temperatures, °F. 9:00 a.m.		10:00 a.m.		10:30 a.m.		11:00 a.m.	
Type paint—	Aluminum	White	Aluminum	White	Aluminum	White	Aluminum	White
Distance from intersection of aluminum and white paint	2 ft.	4 ft.	2 ft.	4 ft.	2 ft.	4 ft.	2 ft.	4 ft.
12 in. above gasoline level	110	97.5	112	101	115	102	Shade*	Shade*
10 in. above gasoline level	109	97.5			115	102	Shade	Shade
8 in. above gasoline level	108	97.5	111	101	113	102	Shade	Shade
6 in. above gasoline level	108	97			112	102	Shade	Shade
4 in. above gasoline level	104	97	108	101	110	101	108	101
2 in. above gasoline level	102.5	96		101	108	101	106	100.5
Gasoline level (42 ft. invent.)	101	94	103	99	103	100	103	100.5
2 in. below gasoline level	97.5	94	102.5	99	102.5	99	102	99
4 in. below gasoline level	97	93	101	98	101	99	101	98
6 in. below gasoline level	95	92.5	99	97.5	100	98	99	97.5
8 in. below gasoline level	94	92.5	98	97	99	97.5	98	97
10 in. below gasoline level	93	92		96	98	97	98	97
12 in. below gasoline level	92.5	91.5	97	96	97.5	96.5	97	96
4 ft. above bottom							97	95

Main body tank temperature was 91° F. by Hg thermometer.
Temperature rusty face west shell just above seal, 11:30 a.m.—116° F.
Temperature aluminum face west shell, 4 ft. above tank bottom, 11:40 a.m.—92° F. (good check of pyrometer vs. Hg thermometer).

*Shade was caused by wind girder.



THERMOCOUPLE LOCATIONS for 1948 floating-roof tank test. Side of tank is at extreme left. Fig. 2.

from beneath the roof and condensation apparently took place each night. The details of thermocouple location are shown in Fig. 2.

2. Comparative Temperature Measurements on White and Aluminum Painted Portions of Tank Shell—1949

Routine inventories on this tank in normal operation during July and August of 1949 confirmed the high loss rates observed in the test work of 1948 with similar natural gasoline even though the tank was now coated with aluminum paint. Visual observation of the seal ring during July-August 1949 revealed the presence of gas blowing from between the seal and the shell as early as 10 a.m. By physically pulling the top of the seal ring away from the shell, it was possible to observe actual boiling of the gasoline surface. However, there was no gas vented from beneath the seal fabric through the safety valve although the fabric ballooned outward.

The shell surface temperatures measured are recorded in Table 4 where it will be noted the boiling temperature of the gasoline was indicated to be approximately 103° F. The gasoline surface behind the aluminum-painted shell was at the boiling temperature from about 9:30 a.m. until some undetermined time in the afternoon. The gasoline behind the white-painted shell did not attain the boiling temperature at any time during the period when the sun was shining on the white surface.

The white-painted portion of the shell above the level of the roof (air on both sides of shell) was 13° F. cooler than the aluminum painted portion (102° F. versus 115° F.) and thereby remained below the boiling temperature of the gasoline. From the ground level up to the gasoline surface, the white-painted shell in the sunlight was several degrees cooler than the aluminum-painted shell.

Application of aluminum paint had not stopped the boiling losses from 13.3-R.v.p. natural gasoline at a main body temperature of 91° F. It was clear that white paint on the outside of the shell would prevent boiling of 13.3 R.v.p. natural gasoline on the east side of the tank in the morning. However, solar heat absorbed by the rusty inner surface of the supper part of the west shell in the morning was conducted to the gasoline surface and did cause boiling. Also, heat radiated from the upper roof deck to the bottom deck and side wall of the pontoon contributed to boiling. The reverse situation would apply in the afternoon.

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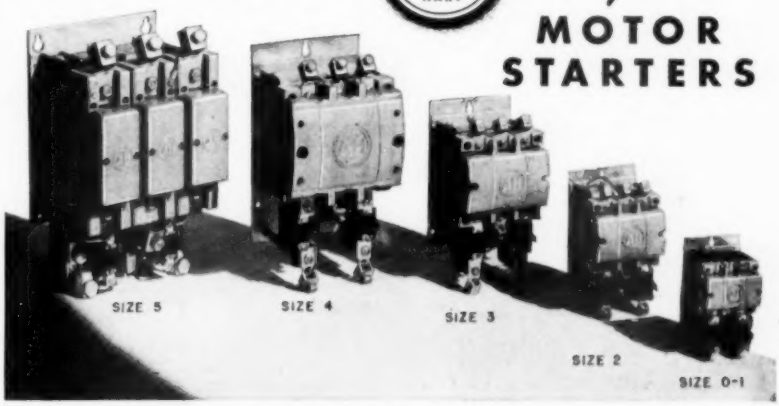

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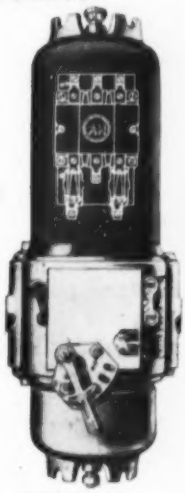

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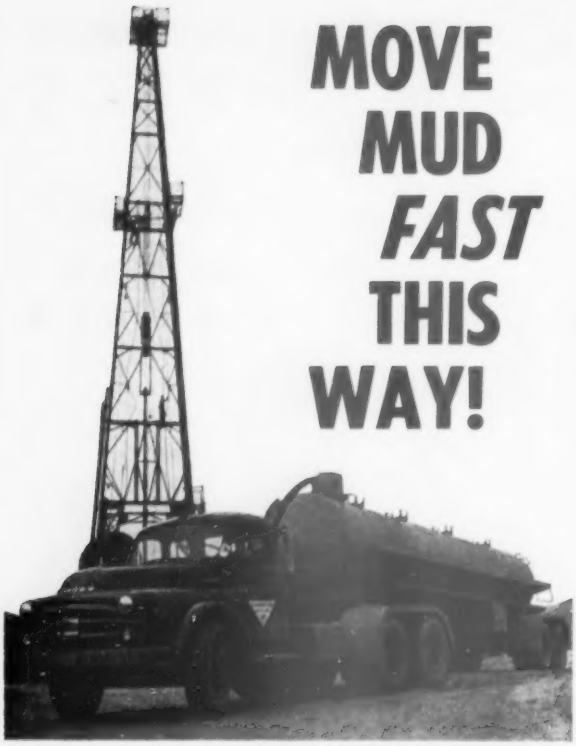

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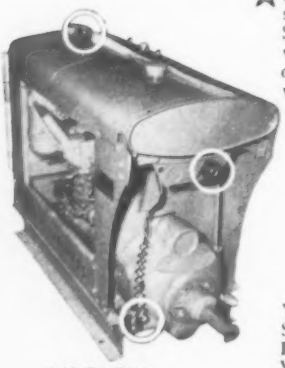

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perature so that heat could flow away from the seal ring by conduction through the liquid at such a rate that the boiling temperature could not be attained. Although painting the shell white would assuredly reduce the main body temperature below the 91° F. prevailing with an all-iluminum-painted tank, painting both roof and shell white would provide the maximum possible reduction in main body temperature. Therefore, it was expected that an all-white tank would not only prevent boiling of 13.3 R.v.p. natural gasoline but might permit storage of higher than 13.3 R.v.p. natural gasoline without boiling losses.

3. Standing Storage Test (All White Tank)—1950

There was no change of inventory in the tank within the accuracy of gaging over a 40-day period starting July 28, 1950, nor was there any visual evidence of boiling. The main body temperature of the gasoline changed only a few degrees (from 84° to 81° F.) during the course of the test; therefore, a log similar to Fig. 1 was not prepared. The white-painted tank was thus indicated to have a negligible hydrocarbon loss in August 1950 (actually 40 days) compared with an indicated loss of 560 bbl. over a 23-day period, August 4-27, 1948. This is positively an indication of the benefit of white paint over red paint. However, as a qualitative measurement of improvement, white paint stopped the boiling whereas aluminum paint did not.

The main body temperature of 84° F. in a white-painted tank in August 1950 compares with a temperature of 90°-92° F. in the aluminum-painted tank in August 1949. This indicates a main body-temperature reduction by the white paint over aluminum paint of the order of magnitude of 7° F.

4. Blending Test (16 R.v.p. in All White Tank)—1951

The main body temperature of the natural gasoline in the tank was 86° F. over a period of several days during and following the blend. There were no visible signs of boiling between the shell and seal ring and there was no gas pocket under the double-deck roof. Since nonboiling losses had previously been demonstrated to be relatively low (Standing Storage Test—1948), it was believed that 16-psi. R.v.p. natural gasoline could be stored in the all-white tank at 86° F. without serious loss.

Bibliography

1. Smith, S. S.; Harden, G. D.; The Oil and Gas Journal, 125, July 14 (1952).
2. Albright, J. C.; National Petroleum News, April 14 (1937).

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GAS DEHYDRATION equipment at Tennessee Gas Transmission's Agua Dulce station in South Texas symbolizes the natural-gas potentialities of this area.

South Texas Resources

South Texas, an area often referred to as the richest area in the United States, is now receiving additional national recognition because of its industrialization. This area may be defined as that section of Texas bounded on the east by the Gulf of Mexico, on the south by the Rio Grande River, on the northeast by the Sabine River, and extending 75 to 100 miles inland.

In this area lie the great refining plants that process the greater portion of Texas crude oil which supplies a petroleum-hungry economy of the United States. The oil industry of Texas supplying about 40 per cent of the nation's petroleum requirements finds its twin, natural gas, just as active along the Texas Gulf Coast. Here is being found, and will continue to be found, great quantities of natural gas which supply power and raw material for a great industrialization that has already begun and will continue its phenomenal growth in the years to come.

These great quantities of natural gas become of greater value and significance when viewed in light of the tremendous quantities of other raw materials found along the Texas Gulf Coast, such as sulfur, gypsum, salt, sand, lime, and shell and the great quantity of sea water that in itself offers in solution form practically all the elements found in the earth's crust. Also supporting this industrialization trend in South Texas is a desirable climate throughout the year, a satisfactory geologic transverse with a seaboard offering ready access to cheap ocean transportation and inland waterways providing a transportation network between plants and markets.

Since the petrochemical industry is expected to lead in new plant construction along the Texas Gulf Coast during the next 25 years, its development may be taken as an indication of the industrial growth that may be expected.

Natural Gas Industrializes South Texas

by F. H. Dotterweich*

THE natural-gas reserves of South Texas have kept pace with those of the entire State of Texas wherein is found more than half of the national reserve of 199.7 trillion cubic feet. In 1952 Texas exported approximately 40 per cent of its net gas production of 4 trillion cubic feet. The reported natural-gas reserves of South Texas are believed to be highly conservative in certain informed circles. This together with the fact that a large proportion of the nation's gas reserves yet to be dedicated lie on the Texas Coast, assures adequate supplies for the ever-expanding industrialization of South Texas.

A stable long-term industrial development becomes assured when natural-gas production from the 3 million acres of submerged land in the gulf is considered regardless of the extent to which it may be explored and developed for crude-oil production. Recent authoritative estimates suggest that within 5 years a yearly production of one-fourth trillion cubic feet of natural gas could be produced from offshore deposits.

The petrochemical industry, when considered in light of its very high investment status, requires but minor quantities of natural gas for fuel and as a raw material, being in the order of about 2 per cent of the present petroleum and natural-gas requirements. At present, desirable raw-material fractions from natural gas for petrochemical production are ethane, propane, and the butanes, which fractions are available on the Gulf Coast as byproducts of natural-gas field processing plants when dry gas is being prepared for pipe-line delivery for export or local use.

Investment . . . Although the growth of the petrochemical industry has been so rapid that it is difficult to make a true appraisal of its investment at any specified time, various investment estimates

*Director, division of engineering, Texas College of Arts and Industries, Kingsville, Tex.

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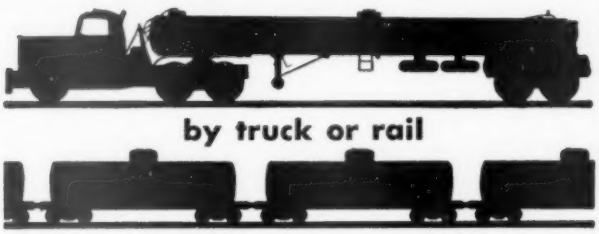

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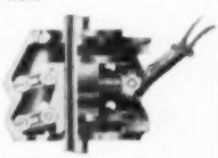

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are of interest. In 1940, investment of less than 65 million dollars had been reported in plants along the Texas coast of similar classification as today's petrochemical operations. This figure rose to about 1 billion dollars and during the postwar period continued to rise until at present about 1½ billion dollars measures this investment.

A reliable estimate of future petrochemical expansion is that contained in the "Resources for Freedom" report issued by the President's Material Policy Commission in June 1952, which indicates that by 1975 an additional 5-billion-dollar investment in chemical plants using natural-gas ingredients as raw material and fuel will be required. It may be assumed that the majority of this expansion will come along the Gulf Coast because of the expected increased production from offshore drilling, from new coast wells, and from reserves presently known but not as yet dedicated (especially to the south of Corpus Christi).

This petrochemical expansion as well as expansion of refinery operations, iron and steel production, cement manufacturing, nonferrous metal production and fabrication will possibly find usable water the limiting factor rather than natural-gas reserves.

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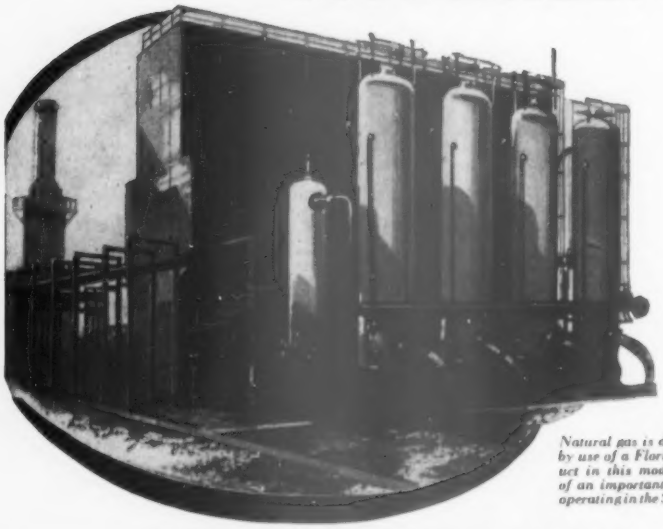

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Raw-Material Requirements

Natural-gas ingredients . . . The Resources for Freedom report previously referred to includes important observations as follows:

1. That chemicals in 1975 will be a relatively minor consumer of natural gas. Hydrocarbon raw materials consumed in producing chemicals in 1975 would be equivalent to only 2 per cent by weight of the probable domestic petroleum and natural-gas requirements. This figure becomes 2.7 per cent by weight including liquid hydrocarbons degraded to fuel gas and 5.5 per cent when all fuel requirements are included for the operation of the chemical plants.

2. About 2.3 per cent of the probable domestic consumption of natural gas (methane, ethane and heavier) in 1975 would be required for the manufacture of ammonia, methanol, ethylene, acetylene, etc.

3. The greater part of the 8 billion pounds per year of ethylene required in 1975 would come from the thermal cracking of ethane and that only 10 per cent of the ethane in the probable 1975 domestic natural-gas consumption would be required.

4. Propylene and butylenes are by-products of cracking operations and their requirements for petrochemical operations in 1975 appeared to be about 11 and 13 per cent respectively of these unsaturates available at that time.

5. By 1975, a tremendous demand for aromatics like benzene, toluene, xylenes, and naphthalene will be realized principally for the manufacture of plastics and surface coatings.

The above estimates and observations indicate that ample natural-gas raw materials will be available to feed the giant molecular machines for the manufacture of petrochemicals and the extent to which they will be required will depend largely upon the accuracy of the plastics demand forecast since 50 per cent of the hydrocarbons used in making chemicals will be required.

The present and future status of natural-gas production along the Texas Gulf Coast assures adequate supplies of natural gas for continued industrialization provided required amounts of usable water are available to supply both industrial and domestic demands. There is presently one deficiency in certain areas toward industrialization along the Texas Gulf Coast and that is usable water. This deficiency in certain areas has influenced the location of plants farther away from the source of hydrocarbon raw material than would be expected.

Usable water . . . The development of any area and especially one which may

be highly industrialized is dependent upon a reliable supply of usable water. A usable-water supply may be obtained from rivers or lakes or it may occur as underground water. The coastal plain of Texas employs both methods to support its economic development and this to a great extent has caused the concentration of its industrialization in the Houston, Beaumont, Corpus Christi, and Victoria areas in the order named. Too, the extent to which the Texas Gulf Coast will share in the petrochemical expansion to come and the respective location along the coast will be in part predicated upon not only the amount of hydrocarbon raw material available, but also the quantities of usable water.

In order that the Texas Gulf Coast acquire its rightful share of the industrial development, it must be assumed that rivers now flowing a considerable portion of their water to the Gulf of Mexico will be properly dammed. The water resources may also be increased by the proper treatment and use of sewage water for industrial purposes as is presently being done by the Bethlehem Steel Co. Sparrows Point plant using sewage-plant effluent from the city of Baltimore.

Intermittent streams may be dammed and flood water injected and stored in water-bearing sands as presently being investigated on the King Ranch and the water-inspection program at El Paso. Likewise, substantial additions to the water resources may be made by locating additional subsurface deposits as hoped for by the survey presently planned for the Rio Grande Valley. The possibility of using sea water for cooling purposes in industrial plants, or the production of usable water from the unlimited gulf waters by ion exchange or by distillation methods must be actively investigated.

Finally, one of the most important methods by which available water can be put to greater use is through the cooperation of industry itself.

An estimate as to the potential industrial development of South Texas by 1975 viewed in the light of the national over-all natural-gas requirements for petrochemicals, as set forth in the President's Material Policy Committee report, may be had by examining the scholarly "Water Requirement Survey Texas Coastal Plain" prepared by the Bureau of Business Research, College of Business Administration, University of Texas, Austin. Included in this survey is a splendid study of resource utilization, industrial development potentials, population growth, and water use for South Texas. Assuming adequate water supply this survey suggests various potential industrial developments as follows:

1. Based on 1948 production figures, the production of petrochemicals (excluding butadiene for rubber) in South Texas will increase tenfold from 2.55 to 26.0 billions of pounds by 1975. The greatest increase will come in the Corpus Christi area from 0.29 to 6.65 billions of pounds.

2. Since all the synthetic ammonia production in South Texas is in the Houston area, it is assumed that future production will come in this area.

3. The demand for chlorine principally for the production of synthetic chemicals suggests an increase from 350 to about 1,600 tons per day by 1975 with the greatest increase occurring in the Corpus Christi area.

4. The survey suggests that other expanding industrial operations in South Texas are iron and steel production, cement manufacturing, wood processing (including paper and pulp), refinery operation and natural-gasoline production, nonferrous metal production and fabrication, sulfuric acid and rubber production, etc.

5. Natural gas has been increasingly sought as the perfect fuel and as a hydrocarbon raw material and being an integral part of the industrialization of South Texas its production in South Texas by 1975 should be in the order of 3¾ trillion cubic feet yearly.

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GULF COAST WATER COOLING . . . NOTES ON

Design, Maintenance, Operation Of Cit-Con's Cooling Tower

Tower has not exceeded design temperature even though plant has been operated at more than 150 per cent of design capacity.

by B. (Bernie) H. Mylius*

THE Cit-Con Oil Corp. plant is located 13 miles southwest of Lake Charles, La., near the center of the Gulf Coast industrial empire. The plant is served by a cooling tower rated at 51,000 g.p.m. with a cooling range of 25° F. with water entering at a temperature of 117° F., leaving at 92° F., design temperature—wet bulb—87° F. and approach of 5° F. The cooling tower is one of the largest in the Southwest. It is 409 ft. 2 in. long, 49 ft. 2 in. wide, 24 ft. 4 in. high and it has 34 cells served by 14-ft. diameter induced-draft fans driven by 40-hp. motors.

*Departmental superintendent, Cit-Con Oil Corp., Lake Charles, La.

Design of the cooling tower was projected to meet plant-capacity requirements under the extremely warm and humid conditions experienced during the summer months in this Gulf Coast area. The tower has not exceeded design temperature although plant production has been more than 150 per cent of design capacity at times. Table 1 gives the results of operation in 1952. These results made maximum production possible regardless of the summer cooling-water temperature — often the limiting factor in many plants.

Numerous changes, schedules, and practices in the design, maintenance, and operation of the cooling tower have been initiated which have proved beneficial and have contributed to dependable operation. Results evolved from study and cooperation of company personnel. Some of the problems and solutions are interesting and they may prove beneficial to others.

Tower location . . . The Cit-Con cooling tower was located approximately 1,000 ft. from operating equipment to avoid corrosion that results from the moisture-laden air near the tower and approximately 750 ft. north of the highway running in front of the plant site so that it would not be the source of hazardous vapor clouds across the highway during winter "northers."

A cooling tower that is free from vibration is obviously desirable. Rigid fan stacks help prevent contact with tips of fan blades and resultant wreckage of fans. Excessive vibration of fan stacks was stopped shortly after operation was started by banding with galvanized angle-iron straps (2 by 2-in.) on the exterior of the stack bolted to flat 2-in. wide strips on the interior of the stack. Optimum location and number of bands was determined by local experimentation. The bands were

TABLE I—AVERAGE COOLING TOWER CONDITIONS FOR 1952*

	Temperatures, °F.									Fans (34)					
	Inlet water			Outlet water			Wet bulb			Differential†			Daily avg. hours oper.§	Availability, per cent‡	Min. temp. oper. for (°F.)
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.			
January	101			77			58			19			795	98.7	65
February	90			71			58			13			786	98.31	65
March	91			73			54			19			800	98.38	65
April	95			76			61			15			814	99.82	Lowest possible
May	99			81			68			13			790	96.92	Lowest possible
June	103	109	97	86	91	83	76	83	68	10	14	6	797	97.73	Lowest possible
July	105	109	101	88	92	84	77	82	72	11	16	7	795	97.45	Lowest possible
August	105	109	97	89	92	79	78	85	65	11	15	6	795	97.45	Lowest possible
September	101	109	93	83	92	76	71	84	57	12	23	6	809	99.17	Lowest possible
October	92			73			56			17			799	98.21	65
November	93			73			53			20			795	99.34	65
December	90			70			50			22			801	99.60	65

*Temperature averages based on readings taken every 2 hours. †Differential is the outlet water temperature less wet bulb temperature. ‡Availability is the per cent of hours fans available for maintaining cooling schedule. §Possible daily fan hours is 816.

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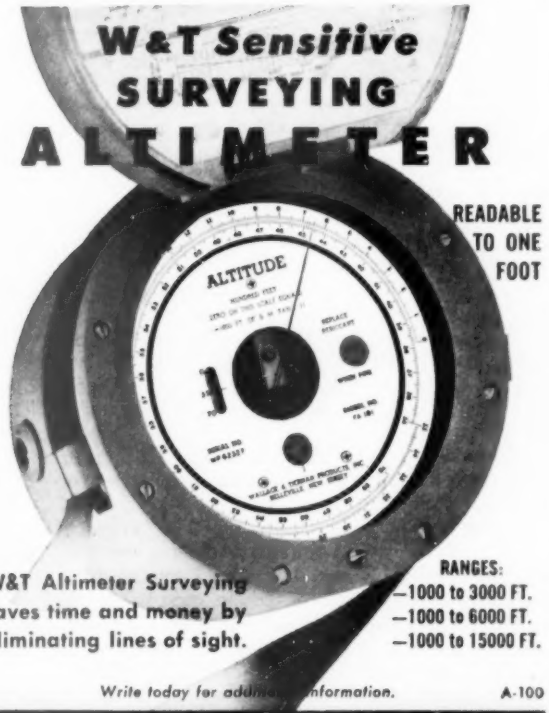

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formed by the manufacturer, galvanized and installed with a turnbuckle arrangement. The bands are undoubtedly one of the main reasons only one fan has been wrecked in 3½ years of operation. Fan wreckage is common in many cooling towers.

Various designs have been used to skim possible oil accumulations from the surface of the cooling-tower basin when leaks develop in tubular equipment throughout the plant. The Cit-Con tower basin is designed to overflow the outlet basin of the cooling tower to plant drainage (settling basin). This is probably the least expensive design but it has been found necessary to break the "suction whirl" to keep from recycling oil that leaks into the system with resultant emulsions. This whirl probably helps dissolve oxygen in the cooling water which could be detrimental in the cooling system.

Maintenance problems . . . Corrosion of the exterior of the fan gear-reduction units appeared excessive the first year of operation. Treatment with automobile undercoating compound seems to have stopped the corrosion and gives a very good protective coating. Further use of this material in the tower as a protective coating is under contemplation.

A spare gear-reduction unit, fan, and motor are kept in repair and ready for installation. When preliminary inspection indicates major repairs of a bad-order unit will be necessary, the entire unit is removed with a crane, replaced with the spare, and the defective unit repaired in the machine shop.

Originally, grass was allowed to grow in the area immediately adjacent to the cooling-tower basin. Dead grass, found in the cooling system, was being sucked into the system when the grass was mowed around the tower basin. An area 30 ft. wide surrounding the cooling tower basin has been covered with shell and effort is being made to keep grass from growing here.

Considerable quantities of dirt have settled in the cooling tower basin and in other portions of the cooling-water system. Dust clouds from the unpaved highway on the south side of the plant have contributed materially to this condition. The highway has been scheduled for paving for some time. Company trucks were using the shelled area on the west side of the cooling tower as a thoroughfare and dirt got into the cooling system from this practice during dry weather. Chains across each end of the tower area are now used to provide limited access for maintenance only.

The electrical conduit serving the motors and the extensive electrical switchgear near each end of the tower was painted with aluminum paint. The water in the system is treated with a chromate compound and windage loss from the tower soon stained this painted surface green with a resulting poor appearance. Protection and good appearance have been obtained here by using a harmonizing green paint.

Deterioration of lumber . . . Some few boards were found in the cooling tower recently that had been attacked by delignification. These boards, for the most part, have the appearance of sapwood rather than heartwood. Sapwood does not have the property of resisting rot. Replacement of redwood in the tower has been with the best grade obtainable for resistivity to rot. The use of asphaltic type of undercoating in certain sections of the tower to prevent attack of the wood is being considered.

Various types of fungus growth were found clinging to some boards in the eliminator section of the tower during a recent inspection-department check. The boards had been attacked and weakened. A biologist termed these growths:

1. "Fern moss," which is not harmful to wood.

2. Lily-shaped fungi that belong to the toadstool and mushroom family. These grow on the wood, take out the sugar, and break down the cellulose structure. This fungi turn loose numerous live cells near the end of their life span which attach themselves to other boards and the cycle starts again.

3. Fungi resembling a brownish crust commonly found in a continuous mass about 1 by 8 by ¼ in. deep. It decomposes wood and releases spores. The spores are very irritating to nasal and throat mucous membranes.

Possible treatment for prevention and elimination of these growths are being investigated.

Lubrication problems . . . Corrosion was found in the tower gear-reduction units in less than a year of operation. By analyses of used gear oil it was determined that corrosion was caused by acidity developed from the additive in the gear oil and the moisture in this location. Use of straight mineral oil for gear oil stopped the corrosion and lubricates satisfactorily.

No large cooling tower will give satisfactory service with infrequent or intermittent inspection. The operator makes a regular round of the top deck of the cooling tower at least every 4 hours. He shuts down any fans that become noisy, start leaking oil at reduction-gear seals, or show any trouble. Production demands determine speed of repairs.

One fan has been wrecked since the plant has been in full operation. Fractured metal parts of one of the wrecked fan blades indicated the failure might have been progressive over a period of time. A weekly inspection of each fan, motor, reduction gear, and fan stack was instituted after this failure. Blank forms are used and the operator checks five fan cells daily. It is believed this inspection has helped detect faults before they cause fan wreckage. Header block valves to cells are operated at least weekly to keep them in good condition.

Corrosion testing . . . Metal test strips are exposed in the cooling-water system under specified conditions of time and temperature and then removed for examination for corrosion or scale deposition. Test strips are exposed continuously in an effort to guard against trouble from changed conditions that might arise in the cooling-water system without warning otherwise.

Some scale depositions on exchanger-tube sheets were caused from accretions built up over dead bugs. The bugs were probably attracted by lights at the cooling tower and the forebay of the circulating cooling-water pump house, died from the heat of the lights, fell into the water, and were then pumped through the cooling-water system and lodged on tube sheets. Insect-repellant lamps were installed in the above-mentioned places and the bugs are not falling in the water from these sources.

The optimum temperature for outlet cooling water during the 6 cooler months of the year is determined, to some extent, by production demands. By operating for optimum outlet temperature, it is possible to reduce fan operation 25 to 50 per cent and this represents a sizable savings in power costs (approximately $4,500 monthly when all fans are operated).

Temperatures are most important in water cooling-tower operation. Cit-Con purchased a "house" constructed according to United States Weather Bureau Standards for the wet and dry-bulb thermometers and it is located more than 1,000 ft. from the water cooling tower in order to avoid any tower influence on temperatures.

Water makeup . . . Treating water in cooling systems may be simplified in the near future by use of demineralized water makeup. This method of water treating produces less than 5 p.p.m. of total dissolved solids and published figures indicate treating costs would be about the same as present costs. The freedom from maintenance that might be expected from circulating water low in total dissolved solids plus the additional savings that would be realized

(Continued on page 306)

New Light on

Gravel-Packing Techniques on Gulf Coast

Here's a review of procedures for this type of well-completion operation, with explanatory diagrams detailing know-how step by step.

by Carter Curry*

IMPROVEMENTS in operations and procedures have made gravel packing an economical and effective method of controlling sand production and permits in part the exclusion of water and gas from the oil production. The principal factors that attributed to the recent improvements are the use of clean fluid when placing the gravel fracturing formation with Bohoflo and acid, the use of finer gravel than that previously used or theoretically required for controlling sand, and the placing of all the gravel in one stage.

Current developments in sand control now permit wells which had encountered severe sand trouble to be restored to normal production at a minimum cost. It is now possible to produce wells from reservoirs that had previously been abandoned because of inability to control sand.

Gravel packing a well to control sand production is not a new idea; it was first used in 1878 by James Dallard in water-well completions.[1]

Gravel packing of oil wells on the Gulf Coast started in 1932 on a small scale; however, when mud was used as the placement fluid a reduced well potential usually resulted.

Gravel packing in California started about the same time and received a much greater welcome there than in the Gulf Coastal area of Texas and Louisiana. The general Pacific Coast technique was to underream the open hole to 14 or 20 in., place a slotted liner in the open hole with the slots blanked off by a sheath of cement or a wash pipe, and place the gravel around the liner by dumping or pumping gravel down the casing annulus. The cement sheath was then drilled out or the wash pipe removed and the well put on production.

In California, the gravel size used ranged from 0.100 to 0.625 in. while the 10 percentile point of the sand ranged from 0.008 to 0.06 in. The Pacific Coast sand formation was generally as coarse as the gravel now being used to gravel pack wells in Texas and Louisiana. Mud generally was used to place the gravel and no appreciable decrease in well potential was noted when these large gravel sizes were used.

In California, 66 wells in 11 different producing sections had been gravel packed by 1938 and were producing 6,400 bbl. of oil daily. Gravel-packed wells pump for long periods before pulling, while the conventional wells during that time were gradually filling with sand or the sand was wearing out the pump, reducing output several days or weeks. When the latter well is pulled, additional down time occurs, further reducing the month's total production from the conventional well.

Better pump efficiencies are realizable when inserting the pump deep within the liner in gravel-packed wells, a practice that is hazardous on account of sanding up in conventional wells. The gravel prevents heaving and acts in part as a gas separator.

The average monthly production per well favors those that are gravel packed by 41 per cent, for a well with conventional completion must be restricted below capacity rates to avoid excessive sand production. The gravel-packed wells may be produced at capacity from the beginning. Gravel packing in 1938 amounted to about 10 per cent of the cost of the well and such cost usually paid out in 1 to 3 years.[2]

Even with success in California very little faith was placed in gravel packing for the Gulf Coastal area until recently because failures due to sand production usually resulted when the gravel size used was large enough to prevent plugging with the mud filter cake.

Gravel Sizes

There has been considerable controversy concerning the maximum size gravel that will retain a given sand, and a large percentage of gravel-pack failures are believed to have resulted because of errors in attempting to use this maximum gravel size. Extensive

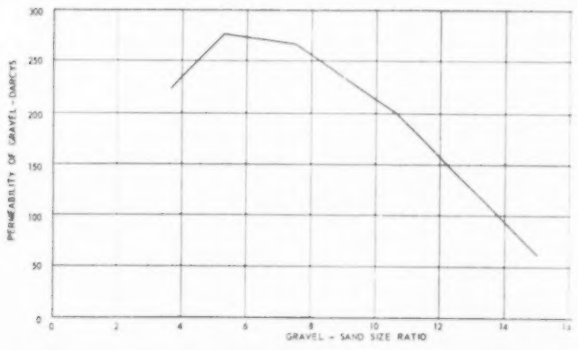

Fig. 1—Permeability of gravel pack after bridging. (After K. E. Hill, A.P.I., Drilling and Production Practices, 1941).

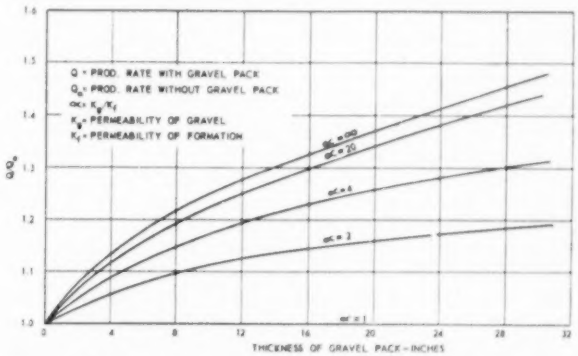
Q = PROD. RATE WITH GRAVEL PACK
Qo = PROD. RATE WITHOUT GRAVEL PACK
α = Kg/Kf
Kg = PERMEABILITY OF GRAVEL
Kf = PERMEABILITY OF FORMATION
Q/Qo
THICKNESS OF GRAVEL PACK - INCHES

Fig. 2—Effect of gravel packing upon production. (After K. E. Hill, A.P.I., Drilling and Production Practices, 1941).

* Chief engineer of Bohorate Tool & Service Co., Houston Sand Control Division.

tests to determine the method of packing using steel spheres of uniform sizes have been run by Coberly and Wagner. It was discovered that practically all of the spheres exhibited hexagonal packing; and the diameter of the circle which can be inscribed within the surrounding spheres when packed hexagonally is 0.154D, where D is the diameter of the spheres.

The diameter of this inscribed circle was considered as the controlling dimension when attempting to stop sand. Production tests indicated that a screen opening twice the size of the sand grains at the 10 per cent point would effectively bridge the sand; thus, the gravel-size ratio necessary to bridge the sand would be 2/0.1547 or a gravel size to sand size ratio of 13. From this, a gravel to sand-size ratio of 10 was considered to have a satisfactory factor of safety.[3]

Gumpertz later ran tests in which the velocity and viscosity of the sand carrying fluid were varied. It was discovered that a gravel-to-sand-size ratio of 11 was effective over the entire velocity range tested while a gravel-to-sand-size ratio of 16 was effective only in the lower ranges of well-rate velocities. It was also found that a gravel pack over 3 in. in thickness did not greatly affect the screening action of the gravel.[4]

K. E. Hill recommended a sand-size ratio of eight. The gravel-permeability values were obtained in a test cell. Fluid flow with sand-laden fluid through the gravel was permitted until apparent stable conditions as to sand invasion resulted. The sand invaded the gravel pack when the grain size of the gravel was about six times the grain size.

Fig. 1 shows that the gravel to sand of 3 to 6 will permit as high a sand-gravel permeability as the 8 to 13 ratio now used by some companies. Also, a more positive bridging action is obtained from the smaller gravel-to-sand-size ratios. This is very important for any sand particle capable of entering the gravel pack would ultimately be produced with a sufficient rate of fluid flow; if not produced a decrease in permeability would result because of the smaller pore spaces as noted by Hill in Fig. 2.[5]

Fig. 2 gives the effect of gravel packing upon production. A comparison of production from a 6-in. hole equipped with a slotted liner and production from various thicknesses of gravel packs surrounding the same 6-in. slotted liner is given. From these data it is seen that the high expense of underreaming a well to a large diameter is not profitable due to the expected small increase in production. No appreciable increase in production

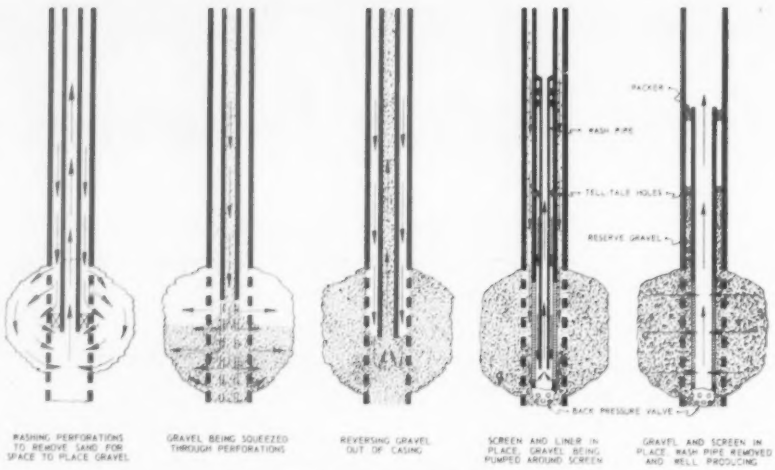
PACKER
WASH PIPE
TELL-TALE HOLES
RESERVE GRAVEL
BACK PRESSURE VALVE
WASHING PERFORATIONS TO REMOVE SAND FOR SPACE TO PLACE GRAVEL
GRAVEL BEING SQUEEZED THROUGH PERFORATIONS
REVERSING GRAVEL OUT OF CASING
SCREEN AND LINER IN PLACE, GRAVEL BEING PUMPED AROUND SCREEN
GRAVEL AND SCREEN IN PLACE, WASH PIPE REMOVED AND WELL PRODUCING

Fig. 3—Gravel packing by reverse circulation.

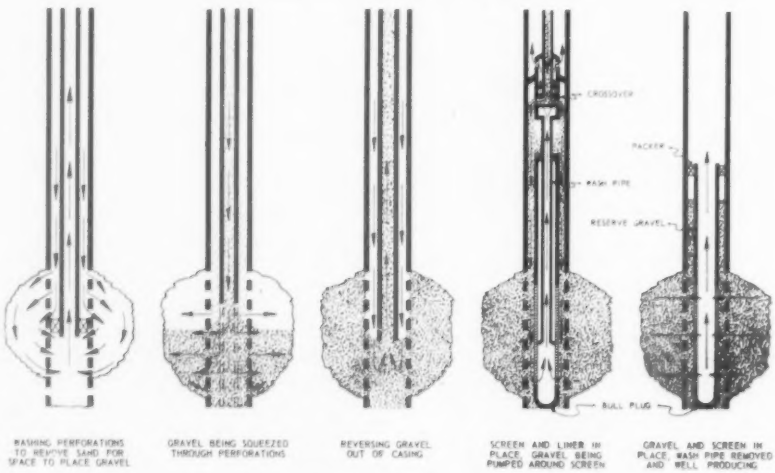
CROSSOVER
PACKER
WASH PIPE
RESERVE GRAVEL
BULL PLUG
WASHING PERFORATIONS TO REMOVE SAND FOR SPACE TO PLACE GRAVEL
GRAVEL BEING SQUEEZED THROUGH PERFORATIONS
REVERSING GRAVEL OUT OF CASING
SCREEN AND LINER IN PLACE, GRAVEL BEING PUMPED AROUND SCREEN
GRAVEL AND SCREEN IN PLACE, WASH PIPE REMOVED AND WELL PRODUCING

Fig. 4—Gravel packing with a crossover tool.

can be obtained by raising the ratio of permeabilities. Since no appreciable increase in production can be obtained by raising the ratio of permeabilities of the gravel after a ratio of 20 has been reached and since even a low gravel-to-sand-size ratio will have a permeability ratio larger than 20, it is to be expected that no appreciable increase in production can even be obtained by the use of large gravel.

The large increase in production not uncommon after gravel packing a well may be attributed to fracturing the sand with special Boho Frac material leaving a more effective drainage area open and thoroughly cleaning the sand face and also to the ability to produce the well at a higher rate without sand difficulty. Bohoflo material has been beneficial to wells gravel packed with mud. The connate water can be removed from the sand thus increasing the effective permeability of the gravel pack and sand, increasing the oil flow.

Many tests were run by the author on gravel-to-sand-size ratios, and it was found that ratios as low as four were necessary to afford a satisfactory sand bridge in some cases. If a 0.03 to 0.06-in. gravel is used to bridge all sand this would have an average gravel to sand ratio of only three. But if a gravel size large enough to give a gravel-to-sand-size ratio of 13 were used, approximately 90 per cent of the sand would be too small to bridge in the large gravel. Both theory and field experience indicate that the use of smaller gravel than previously recommended has no appreciable direct effect on producing potentials. Therefore, the proper size gravel for any sand is believed to be the smallest gravel that will not be plugged by the fluid medium used in completions and which will still be large enough that the individual gravel grains will not pass through the retaining well screen.

The size gravel that fulfills these requirements for unconsolidated sands that have been controlled to date in Texas and Louisiana Gulf Coastal area will range from 0.019 to 0.065-in.

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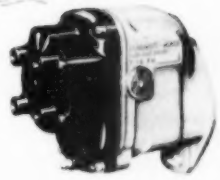

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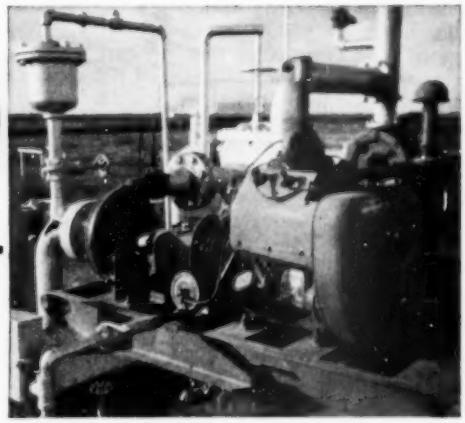

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diameter and should be graded with the maximum diameter not more than 50 per cent greater than the minimum diameter.

These gravel sizes will pass a sand-free liquid suspension of commercial clays; although during completion operations filter cakes may form on the sand face and a large portion of this compacted mud cake cannot flow back through the gravel pack, resulting in decreased well potential. The amount of gravel that can be placed in a well may be diminished by the filter cake if the carrying fluid cannot fracture the formation.

Wells with low formation pressures where returns cannot be obtained with salt water should be fractured by the use of Boho Frac material thus opening up a larger producing interval.

The fluid medium used and the condition of the formation sand face also are of great importance when gravel packing. Even though this water or oil may be only slightly contaminated, the sand face may be plugged by the suspended particles as water or oil is lost into the producing interval. When salt water is used, it is considered beneficial to use formation salt water. When salt water is made from fresh water and commercial salt to increase the weight, it may be beneficial to add calcium chloride in conjunction with sodium chloride along with 2 gal. of Bohoflo for each foot formation being treated in an effort to prevent any base exchange and resulting plugging of the formation by clay particles in the formation sand.

Difficulty has been encountered on some occasions when washing gravel through the small irregular holes made by some of the perforators now being used. When it is necessary to perforate a well prior to gravel packing, consideration should be given to the use of a perforator that obtains a large uniform hole. One-half-inch holes are of sufficient size to prevent bridging by the gravel grains when using small gravel. It may be beneficial to spot Bohoflo fluids in the zone being perforated.

There are a number of methods of gravel packing a well. One of the most common methods used is to wash the perforations, squeeze gravel behind the perforations, and then lower a screen and liner into place.

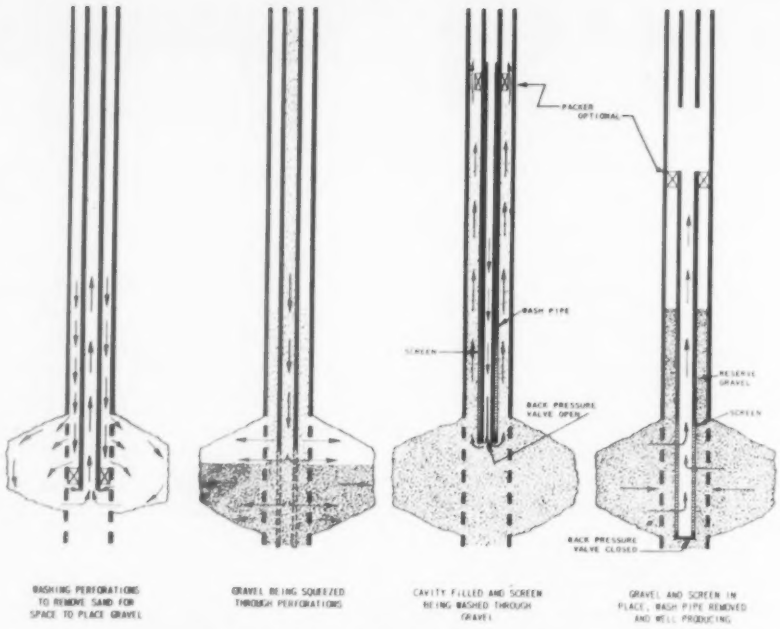

PACKER OPTIONAL
WASH PIPE
SCREEN
BACK PRESSURE VALVE OPEN
RESERVE GRAVEL
SCREEN
BACK PRESSURE VALVE CLOSED
WASHING PERFORATIONS TO REMOVE SAND FOR SPACE TO PLACE GRAVEL
GRAVEL BEING SQUEEZED THROUGH PERFORATIONS
CAVITY FILLED AND SCREEN BEING WASHED THROUGH GRAVEL
GRAVEL AND SCREEN IN PLACE, WASH PIPE REMOVED AND WELL PRODUCING

Fig. 5—Improved method of gravel packing.

A second method of gravel packing is very similar except that the gravel is placed around the screen and liner by circulating gravel down a tubing and out an overhanging apron.

A method of gravel packing found to be more economical is shown in Fig. 3. The perforations are washed, gravel is squeezed behind the perforations, excess gravel is reversed out of the casing. Then a screen and liner are lowered into place and gravel is pumped down the casing annulus and around the screen. When gravel covers the tell-tale holes, an increased circulating pressure indicates that sufficient gravel has been placed around the screen and liner. A liner packer is used with this setting.

A similar method of gravel packing is used in open hole except that the gravel is placed around the screen and liner by circulating gravel down the tubing and out through a crossover joint. Inverted cups direct circulation down around the screen and liner and back up through the wash pipe. Circulating pressure increases when the

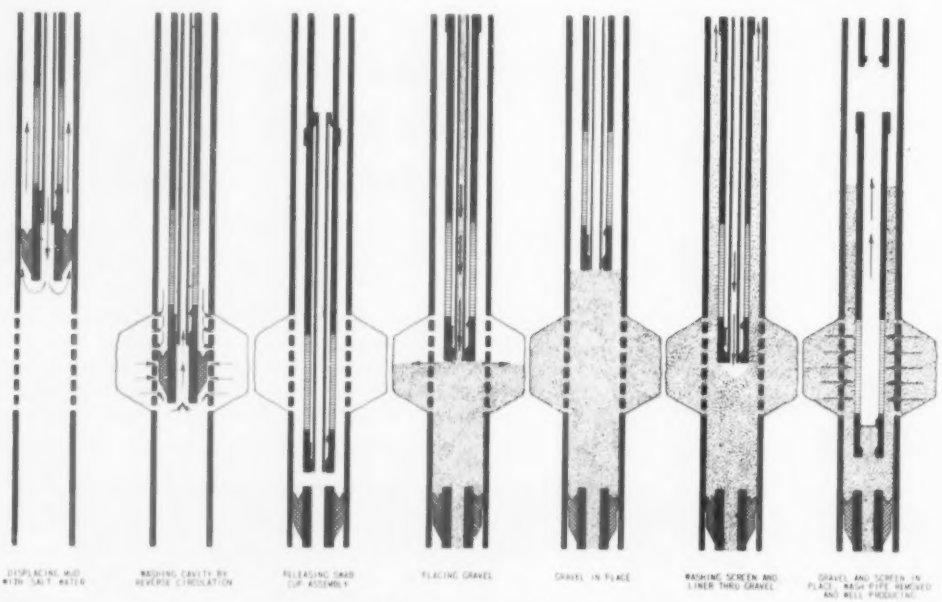
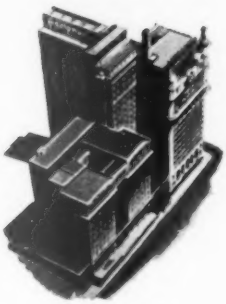

DISPLACING MUD WITH SALT WATER
WASHING CAVITY BY REVERSE CIRCULATION
RELEASING SAND CUP ASSEMBLY
PLACING GRAVEL
GRAVEL IN PLACE
WASHING SCREEN AND LINER THRU GRAVEL
GRAVEL AND SCREEN IN PLACE, WASH PIPE REMOVED AND WELL PRODUCING

Fig. 6—One-half-trip method of gravel packing.



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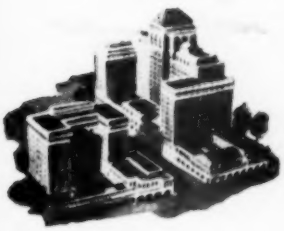

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swab cup inside the liner is raised to the top of the screen section and gravel covers the screen. The correct amount of reserve gravel is then pumped into place. This method can also be used in side casing as is illustrated in Fig. 4.

A method of gravel packing found to be simpler and which consumes less rig time is shown in Fig. 5. For a routine job, the total time required to wash the perforations, place the gravel, and install the screen and liner ranges from 12 to 24 hours, depending upon the depth and amount of gravel that can be placed behind the perforations. This method of gravel packing consists of washing the cavity behind the perforations and cleaning the sand face with Bohoflo fluids if a cavity is present, running open-ended pipe, and pumping gravel down the tubing. When the gravel is about to emerge from the lower end of the string, the blowout preventer is closed and the gravel washed behind the perforations by squeezing the fluid into the formation with a bradenhead squeeze. Occasionally, some of the gravel will settle to the bottom of the hole instead of filling the formation cavity. This gravel may be washed up the casing annulus and then squeezed through the perforations or into the cavity as it settles back to bottom. When squeezing gravel through the perforations, the tubing is moved up and down through the perforated interval to facilitate the movement of the gravel through the perforations. Operations for gravel packing open-hole completions are similar to those for perforated completions except that enlargement of the hole to provide space for the gravel is accomplished by underreaming, or fracturing the formation with Boho Frac and acid.

After the formation cavity has been filled, it is necessary to leave a reserve of gravel inside the casing in case of possible movement of the gravel within the formation cavity. This reserve gravel around the screen and liner above the perforations or open hole also acts as a barrier for movement of sand around the liner, thus eliminating the necessity of a liner packer. After reserve gravel has been placed, the tubing is pulled and the screen and liner run to the top of the gravel in the casing. The screen and liner are washed into place opposite the perforations or open hole, as illustrated in Fig. 5.

A one-stage method of gravel packing has been developed for perforated completions. This method consists of running a wash tool, screen, liner, back-pressure valve, and wash pipe on the producing string. When the assembly reaches bottom, the mud is displaced with salt water and Bohoflo fluid. The wash-tool assembly is set opposite the perforations and a cavity is washed by reverse circulation to clean the sand face and provide space for the gravel. When the sand face is clean and a cavity has been formed, the assembly is set on bottom and the wash tool is released by rotating the tubing to the right. Gravel is then pumped down by normal circulation and washed through the perforations by squeezing fluid into the formation. With sufficient reserve gravel in the casing, the screen is washed through the gravel to the desired depth. The liner is then released by applying weight and right-hand rotation and the wash pipe pulled from the screen and liner assembly. The back-pressure valve is designed to close when the wash pipe, which extends through the valve, is removed. The producing string is then spaced at the desired depth and the well placed on production.

The main advantages of this simplified method of gravel packing are (1) all the gravel is placed in one stage before the wash tool and tubing are pulled and as a result any movement of sand through the perforations into the well bore causing contamination is eliminated, (2) difficulty of formation sand entering through the screen and sanding up the wash pipe inside the liner is eliminated, and (3) the gravel immediately in contact with the screen in the casing annulus is thoroughly washed and evenly graded by the washing action as the screen is washed into place and, as a result, no contamination of the pack in this critical area can occur. It is anticipated that difficulty may be encountered in washing the screen and liner down through producing intervals over 90 ft.

Approximately 100 gravel-pack jobs in 37 fields have been attempted during the past 24 months and 91 per cent of these jobs are considered successful in every case. A severe sand problem had been experienced prior to gravel packing as each well had sanded up at least once. These gravel-packing jobs were performed through pipe ranging in size from 9⅝-in. o.d. casing to 4-in. o.d. liner, in open hole, and in a combination of open hole and perforated pipe. These wells were gravel packed under varying conditions. For example, the water loss into the formation ranged from complete loss of returns to almost complete returns while circulating, and the weight of water ranged from 10.7 to 8.3 lb. per gallon. In most instances, formation water mixed with Bohoflo was used. In a few instances commercial oil production was not obtained even though the gravel pack gave sand-free production. After accounting for failures and noncommercial wells, 91 of the 100 wells gravel packed, or 91 per cent, are now producing sand-free fluid. Based on these results, it is concluded that the gravel packing of oil and gas wells is an economical and effective method of controlling sand production and the main factors which contributed to recent improvements in the operations are:

1. The use of clean fluid and Bohoflo acid eliminating plugging by drilling mud.

2. The use of Boho Frac material to open up a larger producing interval.

3. The use of finer gravel than that previously used or theoretically required by sieve analysis to assure satisfactory bridging of the sand.

4. The placing of all of the gravel in one stage and washing the screen and liner down through the pack to decrease the possibility of the pack becoming contaminated with formation sand and shale and to simplify the entire operation of gravel packing.

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Cit-Con's Cooling Tower

(Continued from page 300)

from more efficient heat exchange would help justify the cost of installation.

Bottom drains in cooling-tower basins facilitate cleanout of same and make possible easier cleaning while operating the tower.

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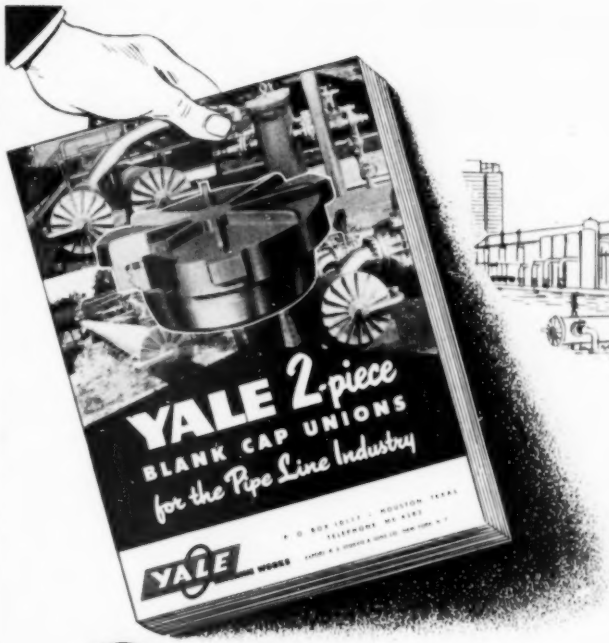

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OIL-FIELD CANCER PROBLEM . . .

South Louisiana Operators Wage Fight On Four Types of Corrosion

- *Water independent*
- *Water dependent*
- *Hydrogen sulfide*
- *Galvanic*

by Jack T. Martin

WELL corrosion in South Louisiana discussed herein, covers oil and gas wells producing from 2,000 to 14,000 ft. that have tubing pressures up to 7,000 psi. The wells are single-zone completions and, with the exception of pumping and gas-lift wells, have a packed-off annulus.

Oil and gas wells in the Louisiana Gulf Coast region combat four types of corrosion: (1) water, independent, (2) water, dependent, (3) hydrogen sulfide, and (4) galvanic.

"Water independent" corrosion occurs in high-pressure and high-gas-oil-ratio sweet-oil wells and sweet-gas wells when as low as 0.1 per cent water is produced. Corrosion activity begins at initial production in this class of well.

"Water dependent" corrosion develops on low-pressure and low-gas-fluid-ratio oil and gas wells that produce high percentages of brine. Corrosion activity may not begin in this class of well until after several years of production.

Hydrogen sulfide corrosion attack when present usually begins upon initial well completion. Fortunately, only a small percentage of the oil and gas wells in South Louisiana produce any appreciable amount of sulfur.

Galvanic corrosion can occur in any well at any time from various types of galvanic couples, such as dissimilar metals or mill scale and clean steel. There is also the possibility of galvanic corrosion developing when casing is set through a series of formations containing waters of varying salinities. Fortunately, prevention of the other types of corrosion often controls the galvanic action that is helping to accelerate the deterioration of the metal in the well, although it has been necessary in certain instances to install insulated couplings to flow lines, polished rods, etc., that were in contact with the casing and tubing to help prevent corrosion from galvanic action.

Corrosion may be considered the cancer problem of the oil field, and in order to combat this menace to oil and gas wells, it is often necessary to study the characteristics of each well. The economics involved to prevent or effectively mitigate corrosion make it necessary to tolerate minor damage; hence, wells are generally classified to determine which require preventive measures. The easiest method of determining which wells are corrosive is to wait until a failure occurs. Obviously, following this procedure alone would result in a treatment of the illness and there would be no inoculation against it. The four most common methods used to detect tubing corrosion before it occurs have been (1) water analysis, (2) metal coupons, (3) tubing caliper surveys, (4) pattern of failures.

Jack T. Martin is a petroleum engineer with The Texas Co., New Orleans. A substantial part of his time during the past few years has been devoted to corrosion problems. Martin began his employment with Texaco after receiving B.S. degree in mechanical engineering from University of Colorado in 1948. While attending the university, he became an instructor in the engineering metallurgy laboratory. At present he is chairman of the Baton Rouge-New Orleans section of the N.A.C.E.

Water Analysis

A typical water analysis from a corrosive oil well in South Louisiana, before and after inhibitor treatment, is given in Table 1.

Well-head water analysis for iron content has been used as a helpful aid to detect sweet-oil and gas-well corrosion, but it is not always easy to procure a sample of water and obtain the correct iron content from it. Some wells produce the water with oil in a tight emulsion while others produce only a small percentage of water. In addition, high-pressure gas wells often require a small water trap in the flow line at the well head to obtain a sample of water.

The total iron content (ferrous and ferric) is generally measured by the aid of a small portable photoelectric cell and hydrochloric acid, thioglycolic acid and ammonium hydroxide as reagents with the water sample. Water samples are sometimes titrated for iron content by using hydrochloric acid, stannous chloride solution, mercuric chloride solution, orthophosphoric acid, and potassium dichromate solution as agents with barium diphenylamine sulfonate as an indicator. It is generally accepted that there is less possibility of error when the iron-content determination is performed at the well location.

The difficulty in analyzing corrosion from the iron content of well-head water is that if the parts per million or

TABLE 1 — MINERAL ANALYSIS OF WELL-HEAD WATER IN "X" FIELD

Ions—	Prior to treatment (p.p.m.)	After treatment* (p.p.m.)
Bicarbonates	N.R.	1,010.0
Sulfates	44.0	32.0
Chlorides	45,578.0	46,740.0
Calcium	1,435.0	1,340.0
Magnesium	298.0	370.0
Sodium	27,514.0	28,453.0
Silica	38.0	20.0
Aluminum oxide	23.0	N.R.
Iron	23.0	7.0
Carbon dioxide free and combined	230.0	N.R.
Organic acids calculated to propionic	1,475.0	N.R.
pH at atmospheric pressure	6.75	7.0
pH after boiling	7.30	N.R.
Specific gravity at 60° F.	1.048	N.R.
Drop size ratio	N.R.	1.96

*Well treated with proprietary semipolar organic stick inhibitor.
N.R.—Not reported.

pounds of iron lost per day are high or low, it does not provide a clear representation of the corrosion occurring. The iron content measured contains the amount that was in the water as it left the producing zone as well as the iron resulting from corrosion. In addition, it is impossible to determine from a water analysis whether the corrosion is occurring evenly throughout the tubing, or if it is localized. In spite of these shortcomings, relative iron content is frequently accepted to determine if corrosion measures have been successful. In Table 1, the iron content is lower in the sample taken after treatment was started. This would intimate that the proprietary compound is retarding the corrosion at least to some degree.

Metal-Coupon Tests

Metal coupons exposed to the well effluents for several days in the flow stream at the well head have been widely used. The coupons are cleaned and weighed accurately to the fifth decimal place before and after being exposed. However, the conditions (temperature, pressure, etc.) that influence corrosion are not the same from the surface to the bottom of the well. A metal coupon represents only that point where it is exposed to the well effluents.

When the rate of corrosion is determined by the average weight loss of the coupon, if corrosive pitting is present, the value does not represent the effective rate of corrosion. The steel-coupon exposures are of little value when they become coated with paraffin during exposures; hence, visual inspection of coupons are sometimes of more value than the corrosion rate calculated from weight loss.

A few coupon tests that proved to be very interesting and rather illustrative of metal coupon exposures are as follows:

Coupons of N-80 steel were set in the tubing of a well at 3,000 ft. and another set was also placed in the christmas tree. Both sets of coupons were left in the well undisturbed for 20 days. Paraffin deposition was present in the tubing from the surface to 2,500 ft. and in the flow line immediately leaving the christmas tree. It was planned to determine what amount the paraffin protected the tubing by comparing the corrosion rate of the two sets of coupons. The chart of a tubing-caliper survey that had previously been run indicated maximum corrosion pits of 0.07 in. in the tubing at 3,000 ft. The coupons in the tubing had a corrosion rate of 0.00924 in. per year, but the coupons in the christmas tree had a corrosion rate of 0.00382 in. per year. On removal, the coupons in the tree were completely coated with paraffin while the ones set in the tubing had no paraffin deposition, but they did have black scale from corrosion over their entire surface area. The well in "X" field was producing 164 bbl. per day of oil with a like amount of brine and had a tubing pressure of 480 psi. with a gas-oil ratio of 980.

The down-hole coupon holder was revised so that it would hold six pairs of coupons. It was then run back in the same well with alloy-steel coupons and set in the tubing at 3,550 ft. A set of N-80 coupons were coupled with a set of 9 per cent nickel steel coupons. A set of 9 per cent Ni and N-80 coupons not coupled together were also placed on the holder. Along with these coupons, sets of 5 per cent chromium steel, 7 per cent chromium steel, and 9 per cent chromium steel were placed on the coupon holder. The various alloy coupons were left in the well for 34 days. The results are indicated in Table 2.

Metal coupons of different metals were set in the tubing of a well in "Y" field at 4,500 ft. After the coupons had been in the well 298 days, they were removed. The results are indicated in Table 3.

This well had 2,800 psi. tubing pressure and was making 93 bbl. of oil

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per day with 270 bbl. of water and 429 M.c.f. of gas per day. The N-80 steel coupons were corroded so that approximately one-half of each coupon was left. The 9 per cent nickel steel coupons showed some corrosion by the presence of heavy black scale; the 5 per cent chrome steel coupons showed considerable corrosion by the heavy black scale on them; the 9 per cent chrome steel coupons were slightly tarnished which indicated there was slight corrosion on these coupons; and the 12 per cent chrome steel coupons showed no corrosion whatsoever and no tarnish of any sort. The N-80 steel coupon exposed at the christmas tree had signs of slight erosion; consequently, it was free of deposition.

Tubing-Caliper Surveys

Tubing-caliper surveys provide a way to determine the effects of corrosion without removing the tubing from the well. Since 1946, over 2 million feet of tubing has been charted in South Louisiana to picture and measure the effects of corrosion.

When water analyses and coupons or tubing failures indicate corrosion is present in a field, a "spot" check is often made to determine to what extent corrosion prevails by running tubing-caliper surveys in some of the wells. If the charts reflect severe corrosion to be occurring, additional wells are calipered. Most of the high-pressure gas and oil wells are periodically calipered to determine the status of the tubing as a safety measure. When there is any doubt of the expected results of a tubing corrosion-prevention measure, tubing-caliper surveys provide an excellent means of determining the value of the treatment after the treatment has been used.

During the initial years tubing-caliper surveys were used, it was desirable to have a survey run when the tubing was new. It revealed original irregularities in the tubing (i.e., mill deviations, mashed tubing, etc.). This so-called "base line survey" provides assurance that later survey run interpretations would not consider such chart deflections as corrosion damage. Better charts from improved instruments and the backlog of interpretation experience do not make surveys on new tubing economically desirable any longer. A scaled measurement of a chart line deflection represents the depth of the pit within approximately 10 per cent. In addition to determining the extent of corrosion damage or the rate of tubing deterioration, the survey

TABLE 2—RESULTS OF COUPON TESTS IN WELL AT "X" FIELD
(At 4,500-ft. depth)

Type alloy steel	Penetration (i.p.y.)	Visual appearance
9% Ni*	0.00033	No visual signs of galvanic corrosion
N-80*	0.01753	
9% Ni	0.00053	Slight black scale
5% Cr	0.00080	Severe pitting
7% Cr	0.00028	Severe pitting
9% Cr	0.00000	Same as before exposure

*A 9 per cent Ni and N-80 coupon were galvanic coupled during exposure to well effluents.

TABLE 3—RESULTS OF COUPON TESTS IN WELL AT "Y" FIELD
(At 4,500-ft. depth)

	Type alloy steel	Penetration (i.p.y.)	Per cent weight loss
A	N-80*	0.0103	28.00
B	12% Cr*	0.0000	0.16
C	N-80*	0.0099	25.00
D	12% Cr*	0.0000	0.12
E	12% Cr	0.0000	0.15
F	12% Cr	0.0000	0.10
G	9% Cr	0.0000	0.04
H	9% Cr	0.0000	0.05
I	5% Cr	0.0000	1.30
J	5% Cr	0.0000	0.90
K	9% Ni	0.0000	1.56
L	9% Ni	0.0000	1.45
M	N-80	0.0071	21.00
N	N-80	0.0078	21.00
O	N-80†	0.0042	11.30

*Coupons A, B and C, D were galvanic coupled during exposure to well effluents.
†Test located at christmas tree.

R/M "Vee-Square"* IS A REVOLUTIONARY NEW TYPE OF PACKING

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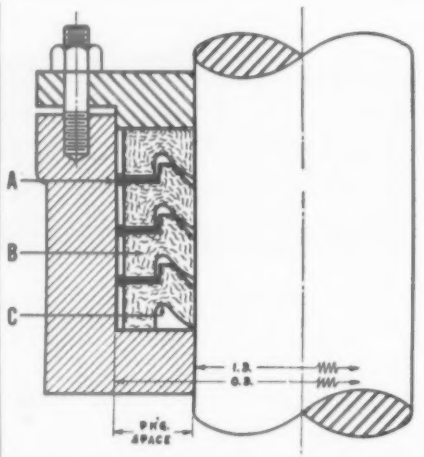

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B. Solid portion is square. Absorbs gland pressure. Keeps packing from rolling and riding rod.

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TABLE 4—"Z" FIELD—TUBING FAILURES IN THE 5,100-FT. SAND

Well No.	Comp. in 5,100-ft. sand	Tubing failure	Tubing life (years)	Brine prod. w./oil (years)	Brine, 50% or more of prod. (years)	Prod. with aid of gas lift (years)	Remarks
A	Dec. 1939	June 1951	11½	8	4	3¾	Holes were found in several joints when tubing was replaced.
B	Mar. 1943	Nov. 1945	2⅔	2	0	2⅓	Tubing parted while fishing for well setting.
C	May 1940	Nov. 1950	9½	7⅓	5½	3	Tubing parted upon removal from well.
D	Oct. 1946	June 1951	4⅔	3⅔	2⅔	1¾	Tubing parted. Numerous holes throughout tubing string. Found hole in casing.
E	Jan. 1947	None	Tubing still in use, Aug. 1951	0	0	0	Tubing caliper August 1951 indicated initial stages of corrosion.
F	Apr. 1947	Aug. 1949	2⅓	2⅓	2	⅔	Tubing parted. Numerous holes throughout the tubing string. Found hole in casing.
G	Used tubing installed Aug. 1949	July 1951	2	2	2	2	Tubing parted. Several joints were split. One joint had 43 holes in it.
H	July 1947	None	Tubing still in use, Aug. 1951	4	1	¾	Tubing-caliper survey August 1951 indicated general corrosion throughout the tubing string. Maximum pit depth 0.094 in.

can reflect the effects of erosion, the location of special nipples, or pup joints in the tubing string, when the tubing is in compression and the presence of heavy deposition in the tubing.

Pattern of Failures

The pattern of well-corrosion occurrence is worthy of notation; although it has often been said that the only consistent thing about corrosion is its inconsistency. Nevertheless, corrosion has been found to be more prevalent in certain fields and particular sands.

In "Z" field there are several oil wells completed in a formation known as the 5,100-ft. sand. The wells produce approximately 115 bbl. of oil per day with 0 per cent b.s. and w. through a 7/64-in. choke and have 900 psi. tubing pressure and a gas-oil ratio of 1,000 to 1 during their early production period.

Wells completed in this zone that encounter water encroachment and approach depletion produce 30 bbl. oil per day with 98 per cent b.s. and w. by gas lift to have a gas-oil ratio of 500 to 1.

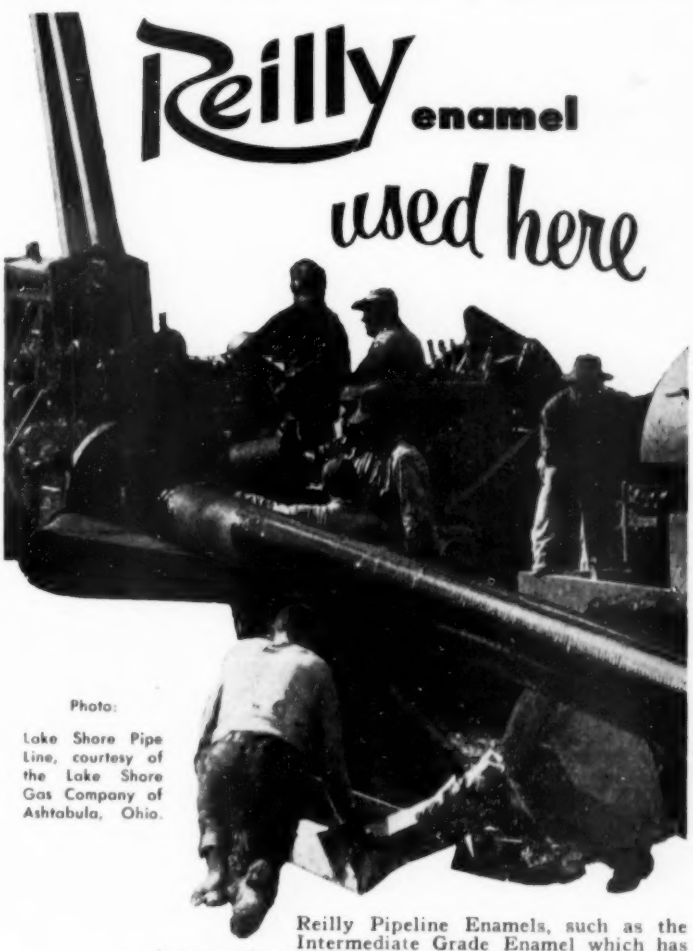
A brief tabulation of data in Table 4 pertaining to tubing corrosion occurring in wells completed in this sand indicates a production pattern that can be used to understand the conditions contributing to the corrosion activity that is being experienced. From this tabulation the following deductions can be made:

1. The 5,100-ft. sand in "Z" field is corrosive.

2. Wells producing from this sand are not corrosive until they begin to produce salt water. Corrosion-prevention measures should be taken when the well begins to make salt water.

3. Gas-lift production is a contributing factor to the corrosion occurring in these wells. (Note that each well that had a tubing failure was produced by gas lifting.)

General observation has indicated



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Lake Shore Pipe Line, courtesy of the Lake Shore Gas Company of Ashtabula, Ohio.

Reilly Pipeline Enamels, such as the Intermediate Grade Enamel which has been used to protect this pipeline, contain only the highest quality materials designed for armed insurance against any type of corrosion. Reilly also offers other Hot Application Coal Tar Base Enamels such as 230 A Plasticized, 230 (AWWA), and Pipeline. A staff of experienced Reilly corrosion engineers are ready to help you determine the correct type of Enamel for your specific need.

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TABLE 5—WELLS (10,000-FT. DEPTH) TREATED WITH ORGANIC INHIBITOR "X" FIELD

Well No.—	B.O.P.D.	B.s. and w. (per cent)	B.W.P.D.	T.P. (psi.)	G.O.R.	Inhibitor cost per bbl. of oil
B-1	42	0	0	1,700	3,150	$0.185
D-1	53	90	480	850	10,170	0.025
G-1	262	55	320	Gas lift		0.009
S-7	160	85	907	Gas lift		0.007
S-10	111	50	111	920	1,513	0.020
S-14	190	80	760	Gas lift		0.009
L-2	180	85	1,020	Gas lift		0.009
L-4	170	85	963	Gas lift		0.006
L-16	103	30	44	3,300	5,810	0.015
L-19	126	50	126	1,300	1,380	0.006
L-26	78	30	32	2,600	5,590	0.018
L-27	165	60	247	Gas lift		0.010
L-37	83	0	0	3,000	6,365	0.052

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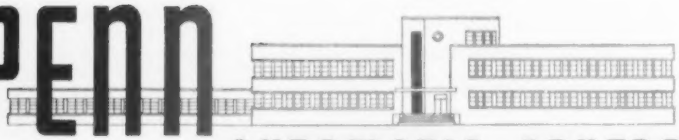

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that sweet-oil or gas-well corrosion usually occurs when there is a high tubing pressure, high gas-oil ratio, large percentage of salt water, or the well is produced by gas lifting. An example of this can be seen in Table 5 which lists a group of wells known to be corrosive and are being treated with organic inhibitor in "Y" field. The fields that have the majority of their wells in this category soon earn a reputation of being corrosive fields.

Special Alloy Tubing

Strings of 9 per cent nickel steel flush-joint tubing are being used in several oil and gas wells. In the process of running this tubing in the well, difficulty has been experienced in slips and tong dies not being able to grip the tubing. The insert dies for the slips had to be changed every 25 stands (3 joints per stand); and every 65 stands, the tong dies had to be replaced. Very little difficulty has been experienced from thread galling; however, care has been taken to have the lift-plug threads in good condition, and the tubing threads carefully cleaned and lubricated before each joint was made up.

In two instances the 9 per cent nickel steel tubing was used as a work string, and both times several pin failures developed during its use. An equipment company tested three samples of the tubing that failed, and it was its recommendation from the results of the tests that 9 per cent nickel steel tubing should not be used for drilling operation where it will be subjected to high torque values and repeated reversals of stress. It appears that this alloy steel as used in tubing has a tendency to be notch sensitive.

The corrosion resistance of 9 per cent nickel steel tubing is felt to be higher than J-55 or N-80 steel tubing. Nevertheless, it does not appear to be free from corrosion attack. An example of this is a well that had a 10,170-ft. string of 2⅜-in. o.d. 9 per cent nickel steel flush-joint tubing replace a string of J-55 and N-80 threaded and coupled tubing in June 1949. The J-55 and N-80 tubing had become severely corroded in 4½ years. A typical gage in 1949 was 228 bbl. per day oil, 1 per cent b.s. and w., 9/64-in. choke, 2,500 psi. tubing pressure, and 1,923 to 1 gas-oil ratio. Tubing-caliper surveys were run in the tubing in July 1950, and August 1951. The latter survey indicated initial stages of corrosion in the lower portion of the tubing string.

A gas well producing 16 million cubic feet per day through 2⅞-in. o.d. 9 per cent nickel steel flush-joint tubing had an iron content of 50 p.p.m.

After a proprietary organic stick inhibitor was dropped in the tubing at a rate of two sticks per day for a period of 30 days, the iron content was reduced to 8 p.p.m. In another gas well producing 9 million cubic feet per day from the same size and alloy of tubing, the iron content was reduced from 206 to 15 p.p.m. by the same inhibitor treatment.

On the other hand, a gas well producing through 2⅞-in. o.d. flush-joint 9 per cent nickel steel tubing in a field where corrosive gas wells are common has made salt water for more than a year. A tubing-caliper survey before and a visual inspection after the tubing was removed for remedial work, did not reflect that any corrosion damage had occurred.

Fully Normalized Tubing

Tubing failures occurring a few inches from the upset, due to ring-worm corrosion have made it desirable to use fully normalized flush-joint tubing as a replacement string. In nearly all cases this has reduced ring-worm corrosion, but in several wells severe pitting the complete length of some of the tubing joints has made it necessary to treat the fully normalized tubing with inhibitors.

Plastic Coatings

Several types of plastic coatings have been used to coat oil-country tubular goods. They can be divided into two groups; i.e., the baked-on plastics and the air-dried plastics. More baked-on plastic coatings have been used to coat tubing and casing used in South Louisiana than any other type of coating. In either case the purpose of the coating was to act as an inert mechanical barrier between the tubular goods and the well effluents.

The thermosetting, baked-on, plastic coating was given a test by running five strings of tubing internally coated with this type of plastic. In each case, the coated tubing replaced corroded tubing. All five strings were installed in March 1951, and had approximately 10 mils of coating. Tubing-caliper surveys were run in one of the wells in February 1952, and another well in May 1952. The surveys indicated that the coating had partially failed in the two wells. A third well was shut in in January 1952, due to a high gas-oil ratio and has pressure on the casing from either a packer failure or tubing leak.

A few years ago the corrosion of gas-lift mandrels made it necessary to replace them approximately every 3 years. In 1948 it became the accepted practice to have the mandrels coated

NEW F.C.C. TOWER LIGHTING REGULATIONS
Effective March 30, 1953
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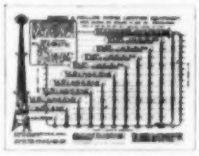

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with thermosetting plastic inside and out. The outside coating was frequently damaged before the mandrel was positioned in the well; consequently, this led to obtaining them with the coating on the inside only. In one area a visual inspection was made, and records were kept on all of the gas-lift mandrels as they were removed from each well. Eighteen per cent of the straight-port-type mandrels had damage occur to the internal plastic coating. This damage ranged from very small breaks to patches of exposed metal 3 in. in diameter. In 1950, initial installations of inclined port mandrels were made. Only 6 per cent of these internal plastic-coated mandrels were found to have coating failures. The use of the plastic coating, better grades of metal, and improved design have advanced the life of gas-lift mandrels well beyond 3 years.

In two particular cases, air-dried vinylite plastic was applied internally to a used string of tubing and in a new string of tubing. They were placed in corrosive wells in different fields, and in both cases there was evidence from high iron content and tubing-caliper surveys that the coating failed within approximately 1 year. The well with the plastic-coated used string of tubing now has a casing pressure of 2,000 psi. Only 3 to 4 mils of coating were applied, and the life of the coating may have been extended if it had been applied to a greater thickness.

Chemical Inhibitor Treatment

Use of chemical inhibitors to protect oil and gas-well equipment is the most popular and widely used method of controlling corrosion. In addition to being economical and relatively easy to use, it also provides protection all the way to the tank battery, while alloy steel and plastic coatings protect only at the point where they are used.

Corrosion prevention by chemical dosage is effective only when the chemical reaches the point where corrosion is taking place. This one factor has been the greatest drawback to the use of inhibitors. However, the economics and success obtained when using chemicals have encouraged the development of both the inhibitors and the means of effectively using them. This type of treatment falls into two categories, (1) neutralizing and (2) organic inhibitors.

The neutralizing or inorganic inhibitors are economically favorable to use, but they require close supervision. It is possible to have solids drop out of solution and plug the tubing if wells produce water containing certain minerals with an alkaline solution. In addition some treating solutions may form a plug due to evaporation from unsaturated gas. Primarily due to this and the shortage of trained personnel, few wells are being treated with neutralizing inhibitors.

Proprietary organic semipolar inhibitors that form an adhesive monolayer film on the surface of the steel and help to create oil wet surfaces in the tubing and casing are being used with outstanding success. They are popular in liquid and solid forms as very little technical information about the well is required before treatment can be started. In a few isolated cases, difficulty has been encountered from emulsification caused by an inhibitor, but in each instance another form of the same proprietary inhibitor or a selected emulsion breaker overcame this problem.

The initial organic inhibitor treatment has usually been with a heavy concentrated batch dosage to provide a film over the complete metal surfaces exposed to the inhibitor solution. After this monolayer film has been laid down, the continued treatment constitutes a makeup of the amount re-

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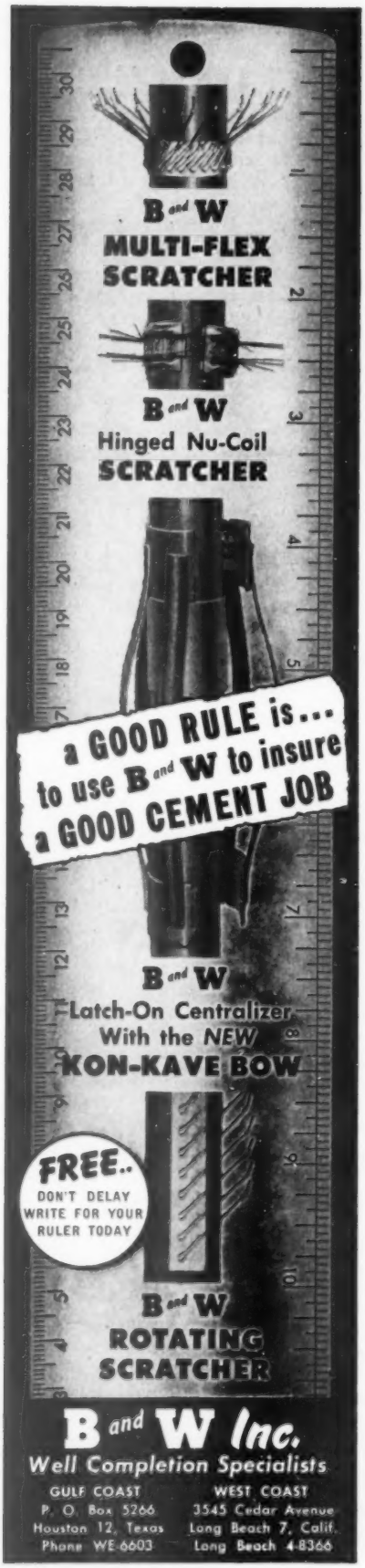

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moved by the washing and solvent action of the production fluids.

The development of stick inhibitor has provided a means of treating wells with a packed off annulus. The sticks can be obtained in varying degrees of specific gravity, melting temperature, and soluble characteristics. Since the majority of wells in the Louisiana Gulf Coast area are completed with packers, this has provided a means of treating the tubing without a large initial investment in treating equipment. Difficulty has developed at various times in the use of stick inhibitor when it "hung up" on paraffin deposition, or from crooked and mashed joints of tubing. When paraffin interferes with the dropping of the sticks, a treatment program is developed to match the paraffin scraping program. The use of 2-in. lubricator with a lift plug crown valve on the christmas tree, rather than a 3-in. lubricator with a gate-valve crown valve, has helped to allow the stick to fall through the christmas tree without hanging up.

Less difficulty has been experienced with the stick dropping to the bottom of the tubing when one stick at a time is dropped, rather than two or three sticks dropped together. In a few cases, it was thought that opening and closing a high-pressure gas well daily to drop the sticks of inhibitor had a tendency to disturb the formation and cause the well to produce sand. The treatment was increased in quantity, but decreased in frequency, and it was felt that the wells involved had a much less severe sand problem. Usually the frequency of treatment by inhibitor sticks is daily or every other day; however, in several instances the wells are treated only twice a week.

The liquid inhibitor is lubricated or injected with a pump into the casing annulus of corrosive pumping wells. High fluid levels in the casing often prevent the inhibitor from reaching the point where it is needed below the fluid. By using hollow sucker rods in such wells, when they become more readily available, this obstacle may be overcome.

In a few instances high-pressure gas wells are being treated by pumping a diluent organic inhibitor in the tubing at the well head. The well is shut in, the liquid is injected and allowed to fall to the bottom or to the fluid level in the tubing. The well is allowed to produce again in approximately 6 hours. The tubing pressure in some of these wells is between 3,000 to 4,000 psi.

In the last 2 years several downhole or bottom-hole chemical-injection valves have been developed to allow injection of liquid inhibitor into the tubing immediately above the packer. When such a valve is used, the casing annulus becomes a reservoir of dilute inhibitor and the valve at the bottom of the tubing is actuated by applying pressure on the casing by means of an injection pump at the well head. Several installations of stationary valves and wire-line removal valves have been reported as having been made in wells approximately 10,000 to 11,000 ft. deep. Apparently very little difficulty has been experienced with the downhole valve, but several failures of the pumps used at the surface to inject the chemical into the casing have been reported. In view of the experiences reported to date, it is to be expected that there probably will be a trend toward further use of these bottom-hole chemical valves.

In a few wells where gas-lift valves were run to approximately 5,000 ft. and the well is several thousand feet deeper, a combination treatment of liquid and stick inhibitor has been used. The liquid is injected into the casing with the gas to protect the casing and upper section of tubing, while the sticks are dropped once or twice a week to help protect the lower portion of the tubing string.

In the experience of the writer, a failure from corrosion has not resulted

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U. S. Government Obligations	158,563,639.90	Bills Payable		5,000,000.00
State, Municipal and Other Public Bonds	14,355,628.38	Acceptances		2,078,482.81
Other Bonds and Securities	535,110.93	Dividend Payable July 1, 1953		112,000.00
Loans and Discounts	109,450,653.68	Reserve for Taxes and Accrued Interest and Expenses		1,759,496.25
Bank Premises	3,049,255.19	Other Liabilities		156,449.28
Other Real Estate	73,041.25	Capital Stock	$ 2,800,000.00	
Customers' Liability Account of Acceptances	1,884,126.06	Surplus	15,200,000.00	
Accrued Income and Other Assets	1,588,260.91	Undivided Profits	4,758,910.09	
				22,758,910.09
TOTAL	$411,221,054.81	TOTAL		$411,221,054.81

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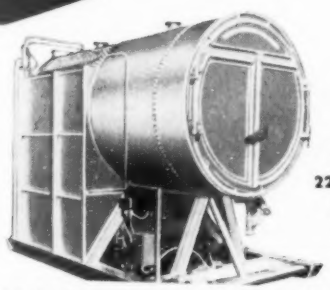

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during the treatment of wells where it was possible to get the semipolar organic inhibitor to the bottom of the tubing. It is felt that extensive use will continue to be made of this class of inhibitor.

Economics of Problem

The type of protection tabulated in Tables 6 and 7 that is used on each corrosive well depends upon the well conditions and economics involved. For example, if an isolated well requiring 2⅜-in. o.d. tubing, was expected to produce for the next 20 years, it would be desirable to use a special steel tubing or a plastic-coated tubing that would last for that period of time although it would cost considerably more than an N-80 grade of tubing. The special tubing would be cheaper than treating with a chemical, since labor would not be involved in the protection after the tubing was run in the well. Yet, if a well was only expected to flow for 1 or 2 more years after corrosion was found to be active, chemical treatment would be the most economical to use.

The cost of organic inhibitor for oil wells ranges from $0.004 to $0.018 per barrel, while the cost of gas-well treatment is $0.27 to $0.87 per M.M.c.f., and the chemical cost per day for gas and oil wells ranges from $0.32 to $2.30. The labor chargeable to chemical-inhibitor treatment averages approximately $365 a year per well.

An example of a well where costly workovers were made necessary by corrosion failures is the G-1 well in Table 5. It was necessary to replace 10,300 ft. of 2⅞-in. threaded and coupled tubing in this well December 11, 1948; the same amount of tubing was again replaced in the same well July 24, 1950. The life expectancy of tubing in this well can then be considered to be 1½ years, without treatment. The cost of replacing the tubing in July 1950 was $18,000. The yearly cost

TABLE 6—TUBING-COST COMPARISON

Tubing and coatings—	Cost per 10,000-ft.
2⅜-in. J-55 EUE, T&C tubing	$5,000
Fully normalized 2⅜-in. J-55 EUE, T&C tubing	5,500
2⅜-in. N-80 EUE, T&C tubing	5,800
2⅜-in. N-80 flush-joint tubing	8,900
2⅜-in. 9 per cent Ni flush-joint tubing	20,000
Thermosetting plastic coating for 2⅜-in. tubing	4,000
2⅞-in. J-55 EUE, T&C tubing	6,700
Fully normalized 2⅞-in. J-55 EUE, T&C tubing	7,400
2⅞-in. N-80 EUE, T&C tubing	7,800
2⅞-in. N-80 flush-joint tubing	11,500
2⅞-in. 9 per cent Ni flush-joint tubing	25,700
Thermosetting plastic coating for 2⅞-in. tubing	5,100

TABLE 7—ECONOMICS OF CORROSION PREVENTION

	2⅜-in. flush-joint 9 per cent Ni tubing	Baked-on plastic coating on 2⅜-in. flush-joint N-80 tubing	2⅜-in. flush-joint N-80 tubing min. treating cost*	2⅜-in. flush-joint N-80 tubing max. treating cost*
Approximate initial cost for 10,000-ft. well	$20,000	$12,900	$8,900	$8,900
Initial cost plus treatment for 5 years	20,000	12,900	12,200	14,920
Initial cost plus treatment for 10 years	20,000	12,900	14,600	20,950
Initial cost plus treatment for 15 years	20,000	12,900	17,000	26,970
Initial cost plus treatment for 20 years	20,000	12,900	19,400	33,000

*Minimum organic inhibitor cost for chemical is $0.32 per day and maximum cost is $2.30 per day. Labor cost to treat well averages approximately $1.00 per day.

For complete specifications write for Bulletin 50.

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due to corrosion could then be said to be $12,000. An inhibitor program, which commenced in this well November 30, 1950, is costing approximately $1,200 per year, including labor. A tubing-caliper survey was run in this well May 17, 1952, 18 months later, indicated a maximum recorded wall reduction of approximately 10 per cent. Based on the 10 per cent reduction during a period of 2 years, it is expected that this string of tubing will last considerably more than 10 years, provided the inhibitor treatment is continued. However, if it becomes necessary to replace the entire tubing string after only 10 years of service, the saving effected by chemical treatment during this time will be considerable, as shown below:

Cost of treatment for 10 years	$12,000
Cost of tubing-caliper surveys at 2-year intervals at $550 per survey	2,750
Cost of replacing entire tubing string at end of 10 years	18,000
Total cost in 10 years	$32,750
Cost of replacing entire tubing string every 2 years for 10 years if tubing is recovered without fishing for it	$90,000

$$\text{Saving from treating} = \frac{\$90{,}000 - \$32{,}750}{10} = \$5{,}725 \text{ per year.}$$

Another example of saving is a pumping well that is being treated by daily injecting organic inhibitor into the annulus with a chemical pump. Records maintained on this well indicate that it was necessary to pull the sucker rods twice a month and replace an average of 10 sucker-rod couplings per month as well as the subsurface pump twice a year, before treatment was started. After 18 months of treatment, no rod failures had occurred and only one pump replacement was required. Prior to treatment, the cost of maintaining the well averaged $6.24 per day; and when inhibitor treatment was used, the maintenance cost was reduced to $3.24 per day which included the cost of chemical; hence, the saving has been $3.00 per day by treating this well to retard corrosion.

Acknowledgments

The preparation of this paper was made made possible through the use of data collected from the operations of The Texas Co.'s producing department in the Louisiana division. Acknowledgment is also given to fellow petroleum engineers who contributed helpful suggestions during the writing of this paper.

BOOKS

ARAMCO AND WORLD OIL. By Roy Lebkicher. Published by Russell F. Moore & Co., 475 Fifth Avenue, New York 17. 112 pp.

The pages of this book relate primarily to a single American oil firm—Arabian American Oil Co. As the only oil-development company in Saudi Arabia, Aramco has had an important role in the development of that country. Here is the story of how Aramco, some years ago, concluded a concession agreement with the Kingdom of Saudi Arabia, undertook lengthy and extensive explorations, and finally discovered the vast reservoir of oil that lies in the eastern part of the kingdom. Here is an account of how the oil operations were conducted and how the preliminary geological explorations, the drilling, production, and the transport of the oil from well to refinery were accomplished. Here, too, is the story of the vital part played by the many services supporting these operations—the medical, personnel, training, engineering, transportation, communication, and others.

THE ARABIA OF IBN SAUD. By Roy Lebkicher, George Rentz, and Max Steineke. Published by Russell F. Moore Co., 475 Fifth Avenue, New York 17. 179 pp.

This volume treats of the geographical, historical, and cultured backgrounds of the Middle East, particularly of Saudi Arabia. The first part of the book discusses the ancient history of the Middle East and early Arab civilization, the rise of Islam, and the historical events culminating in the establishment of the modern Kingdom of Saudi Arabia. The government, populated centers, industries, and geographical characteristics of the Arabian peninsula are then discussed in detail. A final portion of the book offers a scholarly account of the religion, literary heritage, and social customs of the Arabs. There are many maps and photographs, and the reader will find in the book a concise portrayal of one of the world's least known and yet most important areas.

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Inland-Water Drilling

(Continued from page 175)

foundation on which to mount a rig.

2. Piling structure for rig base . . . This method is used where water is too deep to employ a conventional drilling barge, or in landlocked bays which offer no means of ingress or egress by drilling barges. The arrangement is also useful where drilling barges are not available. Piling structures usually are very costly and require a considerable amount of time to build because they must be stressed to support a million or more pounds of drilling rig and pipe.

3. Submersible drilling barge . . . This method of offshore drilling is by far the most economical and is the fastest for drilling in inland waters. A minimum of protective piling is needed; if a location is within the water-depth limitations, and is accessible by channel or deep water, it can be prepared and made ready to receive a barge within a very short while. The barge can be moved in, submerged, and made ready to drill in a few hours. After completion of the well, the barge can be pumped out, moved to another location a mile or so away, settled on location, and drilling again in only one-half day.

Most drilling barges draw about 4½ to 7 ft. of water and can be submerged in water up to 14 ft. in depth. However, in water more than 10 ft. deep, a shell mat must be laid as a foundation.

If the water is not deep enough to allow tug-and-barge traffic, it will be necessary to dredge a channel to the location and an additional area around the site sufficiently large to accommodate the various barges required in drilling and servicing the rig.

Standard protective structure for drilling barges consists of two three-pile clusters of treated, wooden piling driven near the ends of the barge on each side, with single piles spaced in between end clusters. Spaced pilings serve to prevent the barge from shifting with wind and tide and protect it from damage from boats, tugs, and service barges which will come alongside during the drilling period.

In addition, a well-protective structure called a "pig pen," the equivalent of the cellar in land rigs, is built around the location stake. This structure is designed to fit the slot of the drilling barge and is usually about 7 ft. square, or 1 ft. less than the width of the slot. It will serve as a guide for the barge while floating it on and off location and also protect the well head from damage by contact with the drilling barge.

Pig-Pen Designs Analyzed

The three most popular designs of pig pens are:

1. Caisson type . . . This type, usually circular steel casing about 7 ft. in diameter, is sunk into the bottom of the bay. The casing may be filled with concrete to the top of the surface casing for added protection of the well head against storm and collision damage.

2. Wooden-piling type . . . In this case, treated wooden pilings are driven into the bay floor. This arrangement forms a rectangle with less width than the barge slot and with added length to allow the construction of a working platform when the well is completed.

3. Steel-piling type . . . This type of pig pen employs 6 or 7-in. steel casing as piling and is constructed to the same dimensions as the wooden-piling type. The steel casing is driven deep into the bay floor to form the corners. A prefabricated, reinforced structure of larger-diameter pipe is then lowered over the corner pilings and is welded

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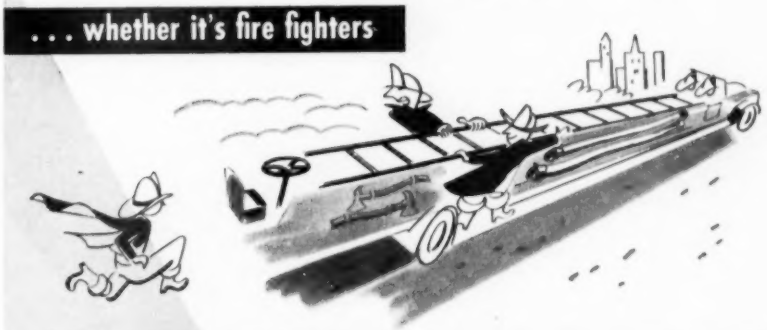

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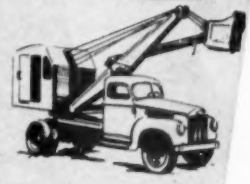

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in place after the well is completed and the barge is moved off.

Usually, about 160 ft. of 16 or 20-in. conductor casing is set and cemented at commencement of drilling operations. Usual practice is to drill the conductor hole with salt water so that no bay water contamination by drilling mud additives is caused. With the conductor casing in place, mud can be mixed, the surface hole can be drilled and surface casing set.

Offshore-Drilling Problems

Offshore drilling presents many problems not encountered on land operations. Precautions must be taken to prevent pollution of the surrounding water by oil or drilling mud; consequently, mud control is highly important.

For example, cuttings from the shale shaker must be washed clean before disposal. When an excess volume of mud accumulates, it must be disposed of by pumping between strings or barged off for disposal on shore.

Ample facilities for mud and chemical storage must be available on location to eliminate the time-consuming task of hauling large quantities of these materials to the location in the event of an emergency.

Drill-stem testing must be done in conjunction with a shore battery or into a tank barge. It is also necessary to run a circulating sub so that fluid accumulated in the drill stem can be reversed out into the test tank.

Transportation of personnel and supplies to the location presents another problem. Dock facilities must be found or built as near as possible to the drill site. These docks must include a loading ramp sufficiently heavy to allow service trucks and supplies to be conveniently loaded on service barges. The docks must afford sufficient space to accommodate several personnel boats.

Usually a tugboat, two service barges, and at least two personnel boats will be needed. One boat should be kept in a standby status at the rig at all times to provide rig-to-shore transportation in the event of accidents or for the conveyance of urgently needed supplies. Another boat is needed for crew transportation and hauling light supplies, and an additional one should be available for use by the tool pusher, geologists, and supervisors.

Planning pays off . . . A great amount of advance planning will pay off in any offshore operation. The tool pusher, purchasing agent, and production department must anticipate the materials needed and lay out a transportation program several days ahead of actual anticipated needs.

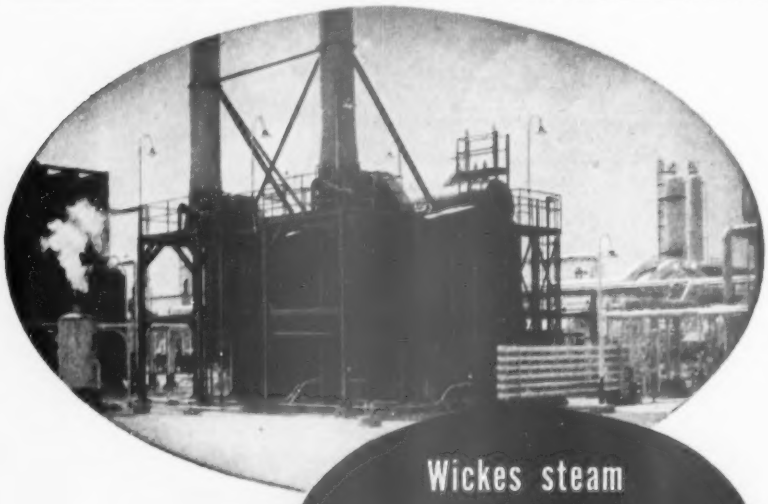
More supplies and replacement parts must be kept on hand aboard the drilling barge than on a land rig (where a telephone call to the nearest supply store has the needed supplies loaded into a truck and on the way to the location in a short time).

Transportation of the lighter and less-bulky supplies to the offshore location may be accomplished by the use of one of the boats. However, heavier equipment necessarily must be loaded on a service barge and towed to the location.

Production Problems

Problems of producing offshore wells are more complex than those encountered in wells completed on land.

For example, dual completions are impractical in offshore operations because of the necessary regulations set up by the state and federal bodies which have jurisdiction over offshore production. These regulations require that a production packer be set and the annular space between the tubing and casing be filled with drilling mud. It is good practice to mount in the tubing string a side-door choke which can be set and removed by a wire line. This procedure will allow mud to be circulated during the course of work-



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ing over a well without resorting to removal of the tubing head.

In addition, an automatic "storm choke" is required. The storm choke has two control units. A subsurface unit, similar to a bottom-hole choke is run on a wire line in the tubing and set on slips at 4,000 ft. in a 7,000-ft. well as an example. This arrangement constricts the tubing flow to the positive choke size of the unit. If the flow pressure drops under 150 psi. below normal, the choke automatically shuts, closing in the well. In the event of damage to the christmas tree by hurricane or boat collision, the well thus is held under control at the placement point of the controller.

In addition, a surface unit, placed on the well head, controls the flow-line pressure. Under those conditions where flow-line pressure rises or falls below certain limits, this unit shuts off the well at the well head, insuring that the well will be shut in if damage is done to the flow line. Storms, boats, or dragged anchors, could break the flow line.

Oil from contiguous state leases in one block may be commingled with express permission of the State Land Commission and the Railroad Commission. In this case, however, the state must be paid on the basis of the crude price of the highest gravity oil produced. Arrangements must be made for individual testing of each well.

Flow lines and oil-storage problems present big headaches for the offshore operator. Flow lines must be coated and wrapped for protection against excessive salt-water corrosion and must be buried at a sufficient depth to prevent damage from boat propellers or anchors. The simplest and cheapest method of laying flow lines involves coating and wrapping on shore, welding the joints in sections as long as practical, suspension from floats, and towing the string by tugboat into the marked channel. Empty oil drums serve excellently as floats for this operation.

The pipe-line ditch is plowed or jetted with a high-pressure pump set on a tug which drags a discharge jet on bottom.

When the line is in position over the channel, the sections are welded on a work barge. Float suspension lines are cut and the pipe will drop into the channel by gravity. Wave action will soon cover the line with silt and sand much more effectively than would be done by men or machines.

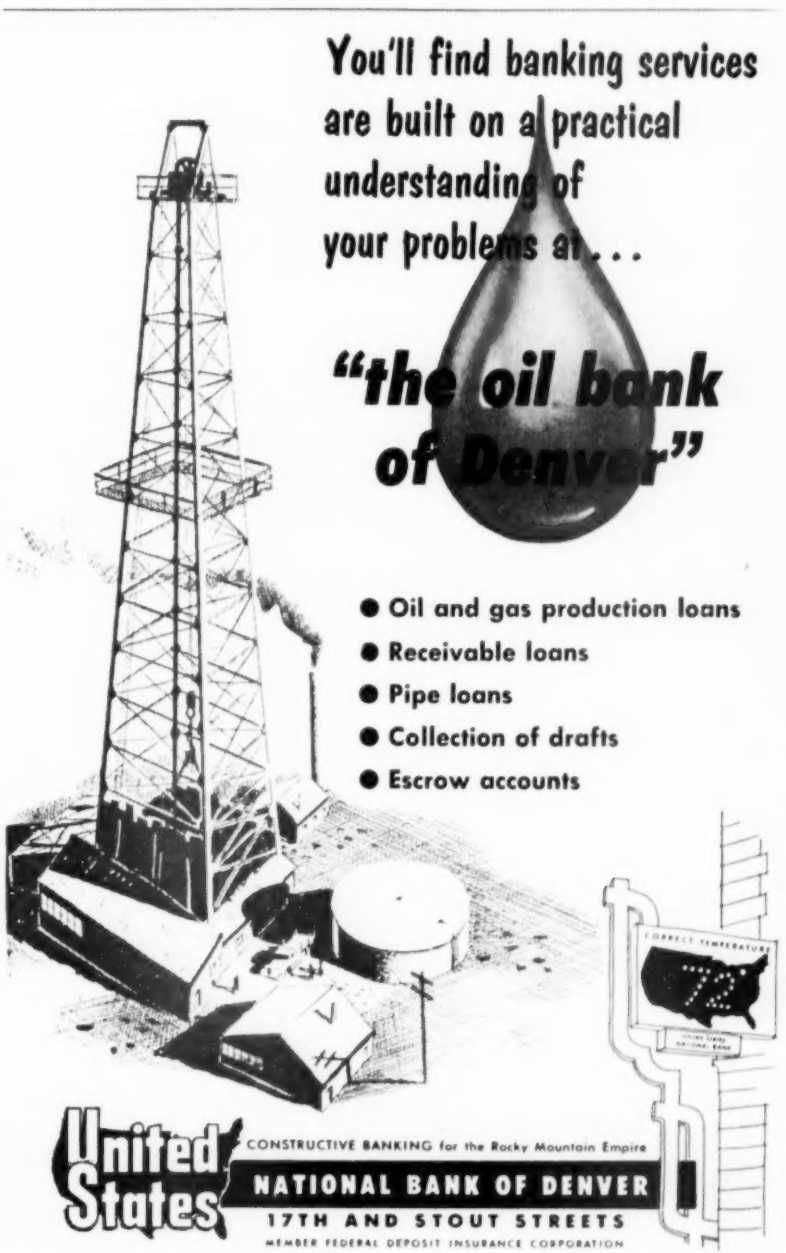
Tank-Battery Arrangements

Several types of tank-battery setups are employed in offshore operations; each type has its own special advantages under varying situations. If production is within 2 or 3 miles of shore (where a suitable site can be found for situating the battery and if a pipe-line connection or good road over which crude can be trucked is available), a shore battery is much more feasible and economical despite the long lines required. However, if the distance to such a land location is too great, several offshore battery setups can be used.

One of these is the built-up island, consisting of a confining bulkhead to prevent washing out by wave action, and filled with sand or shell. It is difficult to build bulkheads sufficiently water resistant to prevent settling or washing away of the fill material which action results in a fairly unstable tank platform. Washing and settling action can be lessened by setting the outside bulkheads on an angle of 45° or more, slanting-down and out from the center of the platform. The entire fill should be floored over.

A second method employs piling driven into the bay floor to support a platform which is constructed high and sufficiently above danger of wave damage. (Wave damage occurs usually 10 to 15 ft. above mean high-tide level.) Tanks and separators may then be built on the piling-supported platform and facilities may be provided for tying up and loading oil barges.

Flat barge mounting . . . One company has mounted tanks and separators on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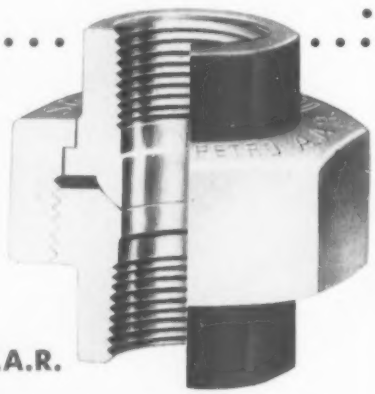

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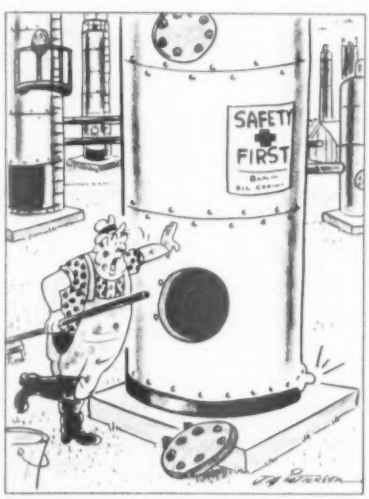
a conventional flat barge. A shell mat was laid on the bay floor as a solid foundation. Then the prepared barge was towed onto location and sunk into position on the shell mat, which was built to leave 3 or 4 ft. of barge above mean high-tide level. Piling was then driven around the barge to prevent shifting and to provide a buffer between the barge and oil transport vessels.

Probably the best setup is the prefabricated battery barge, constructed in a manner which allows it to be floated onto location and sunk into position. The substructure is built similar to that of a conventional flat-top service barge. It is equipped with sea cocks which can be opened for submersion. Steel casting supports, 15 to 20 ft. high, are built onto the top of the barges and storage tanks are constructed on these "legs." Storage tanks will be of approximately the same outside dimensions as the submerged base, rectangular in shape and 10 ft. or more in depth. Tanks are bulkheaded into separate compartments; their level-top construction offers less wind and wave resistance. Separators, heaters, and other pieces of equipment are built as integrated units into the upper deck of the battery barge.

Since the top of the submerged base barge is well below the surface of the water, the effect minimizes the amount of surface exposed to wave action. This type of barge can be disconnected, pumped out, and floated to a new location with little difficulty and in a minimum of time.

Acknowledgment

The author acknowledges the assistance of Fritz Harsdorff of the Corpus Christi Caller-Times in the preparation of this article. Goldston Co., Corpus Christi, submitted data on permit procedures and requirements.



"I hope you haven't fallen on your big fat face again, Yardley."

Compressibility Factors—Universal Chart

A UNIVERSAL chart using critical temperature and critical pressure as parameters instead of gas specific gravity, is shown in Fig. 1. The data employed in constructing this chart were read from an enlargement of the generalized chart presented by Obert.[1] Fig. 1 was not extended into the region where reduced temperature is less than 1.0, although this may be easily done. A comparison of this chart with the source data has been made in Table 1.

A chart for natural gases was presented in the June 15 issue.

Reference

1. Obert, E. F., Ind. & Eng. Chem. 40 (1948), page 2185.

TABLE 1—COMPARISON OF UNIVERSAL CORRELATION (FIG. 1) WITH SOURCE DATA

Material—	Propane	Propane	Hexane	Toluene
Temperature (°F.)	250	1,200	900	1,100
Pressure (psia.)	250	3,000	1,200	1,200
T_c (°R.)	665	665	916	1,068
P_c (psia.)	616	616	440	611
T_r	1.068	2.50	1.48	1.46
P_r	0.405	4.86	2.73	1.96
Z factor:				
Present work	0.875	1.042	0.805	0.84
Obert[1]	0.88	1.042	0.805	0.83

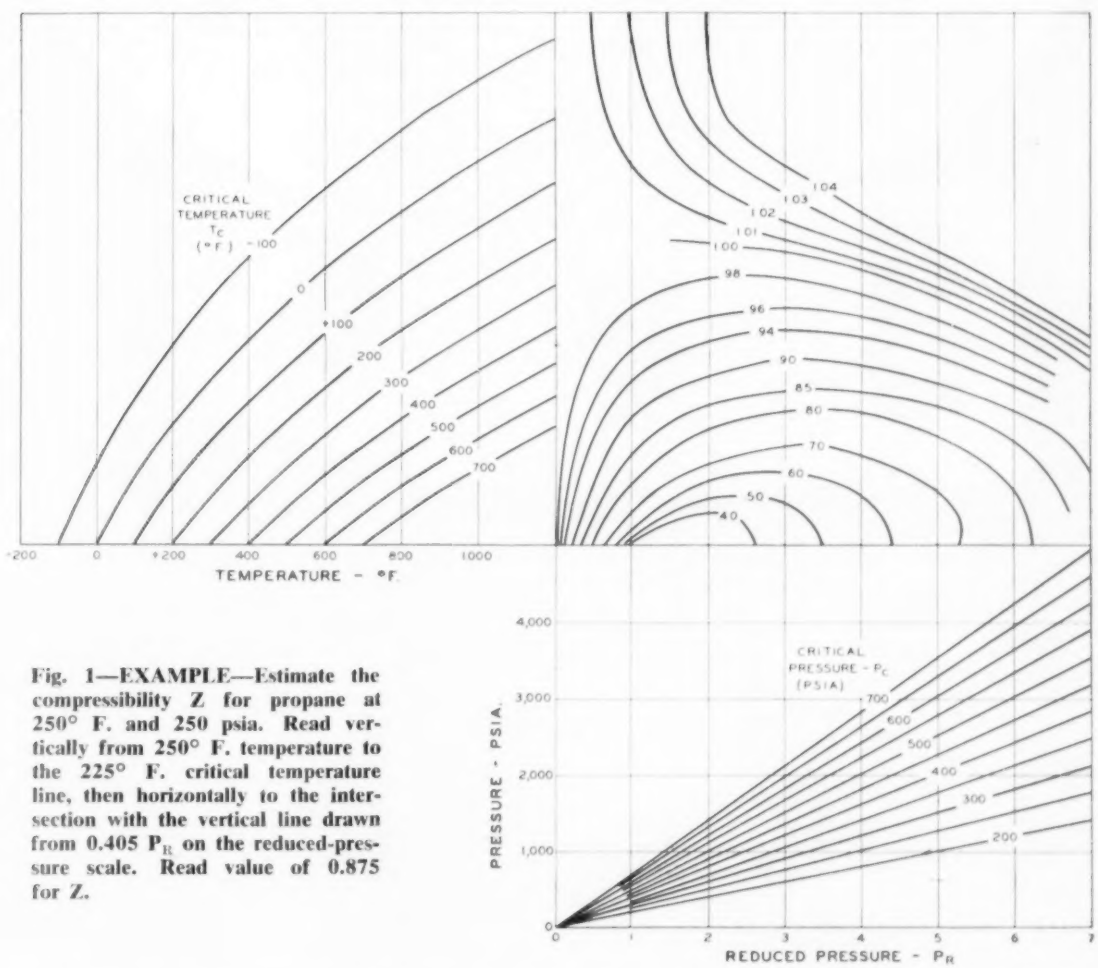


Fig. 1—EXAMPLE—Estimate the compressibility Z for propane at 250° F. and 250 psia. Read vertically from 250° F. temperature to the 225° F. critical temperature line, then horizontally to the intersection with the vertical line drawn from 0.405 P_R on the reduced-pressure scale. Read value of 0.875 for Z.

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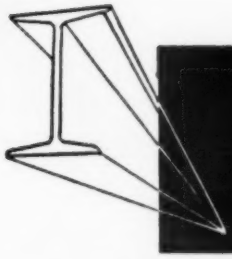
by W. L. Nelson
Technical Editor



PROGRESS IN METALS

Prices of Alloys and Plastics

IN estimating the costs of alloy steel or special metal equipment even for comparison purposes, the "shape" of the basic material is extremely important. Relative to the cost of forging billets, the costs of other alloy steel shapes are about as shown in the accompanying small tabulation.

Pig iron, basic	83
Forging billets	100
Bars and structural	117
Strip:	
Hot rolled	119
Cold rolled	155.5
Plate	135.5
Sheet	162
Seamless tubing	*263

*Estimated.

Similar data in Table 2 for the relative costs of carbon steel shapes do not entirely substantiate the above data on alloy steels. However, the cost of various high-alloy tubes can be estimated with fair accuracy from the "bar" costs of Table 2 by multiplying by 2.25.

Obviously the costs of fabricated equipment such as pumps, exchangers, etc., are not increased by the ratios indicated herein. The costs of these will be indicated in other Progress in Metals pages.

TABLE 1—PRICES OF COMMON METALS, BRIGHT ALLOYS, AND PLASTICS

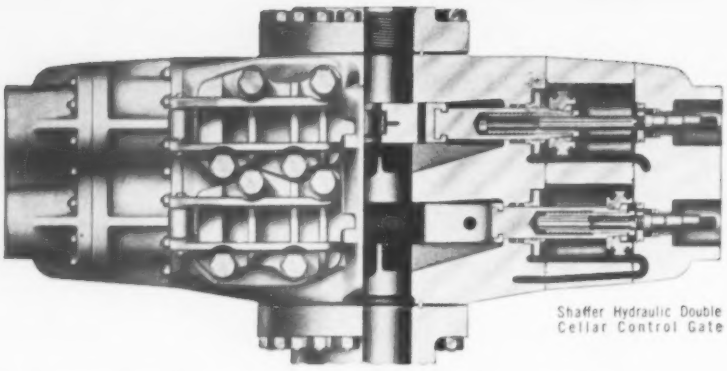
	Cents per lb.	Year
METALS		
Pig iron	2.32	1951
Steel billets	2.8	1951
Magnesium	24.5	1952
Aluminum ingot	19.0	1951
Copper, electrolytic	24.5	1951
Lead pig	17.5	1951
Nickel, cathods	54.0	1951
Monel	33.0	1951
Yellow brass rod	32.2	1951
Zinc, slab	18.8	1951
Bronze	33.5	1952
Tin	$1.32	1952
Titanium	$6.00	1952
Manganese	32.0	1948
Chromium	89.0	1948
Vanadium	$2.80	1948
MAGNESIUM ALLOYS		
Ingot	20.5	1946
Alloy ingot	23.5	1946
Smelter ingot	14.0	1946
Sheet—0.25 in. down to 0.032 in.	48-90	1946
Tubing—3 in. by 0.25 in. down to 0.5 in. by 0.12 in.	57-95	1946
Bar and rods, 2 in.	42.5-46	1946
Bar and rods, ½ in. and less	48-58	1946
Extruded shapes	47.5-55.5	1946
PLASTICS		
Phenolic	20	1952
Polystyrene	32	1952
Urea	33	1952
Polyethylene	55	1952
Cellulose acetate	46	1952
Vinyl polymers	54	1952
Melamire	47	1952
Cellulose acetate butyrate	62	1952
Ethyl cellulose	72	1952
Acrylic resin	70	1952
Polyamide (nylon)	$1.60	1952
ALUMINUM ALLOYS		
Ingot	15.0	1946
Smelter ingot	10.5-14.0	1946
Sheet, 2S and 3S:		
9-gage 12 by 48-in.	27.9	1946
17-18-gage 26 by 48-in.	31.7	1946
21-22-gage, 24 by 42-in.	21.2	1946
Plate, ¼-in.:		
2S and 3S	24.2	1946
24S	22.8	1946
Extrusions	25.5-34	1946
Tubing, 2 in. by 0.065 in.:		
2S½H	40.0	1946
52SO	61.0	1946
24S	67.5	1946
Screw machine stock	26-29.5	1946

TABLE 2—APPROXIMATE PRICES OF ALLOY STEELS—1946 AND 1951

Name of material—	Approx. composition Cr	Ni	Mo	Si	Cents per lb. 1946	1951	Ratio to cost of carbon steel
Carbon steel:							
Billets					1.72	2.8	
Plate					2.14	3.95	
Sheet, annealed					3.45	3.95	
Strip, cold rolled					3.03	4.65	
Structural					2.32	4.0	
Bar					2.44	4.08	
SEAMLESS TUBES							
Boiler, 2 by 2¼					6.7	12.0	
Killed carbon				0.2	*5.55	9.25	1.0
Carbon moly			0.5	0.3	*7.7	13.0	1.4
Silmo			0.5	1.5	*8.4	14.2	1.53
Manganese moly			0.3	0.3	*7.3	12.3	1.33
Sicromo 1	1		0.5	1.25	*10.4	17.6	1.9
DM	1.5		0.5	0.75	*10.3	17.4	1.88
S.A.E. 3120	0.65	1.25		0.27	8.5	14.1	1.52
S.A.E. 4615		2.0	0.25	0.27	*8.7	14.7	1.59
Croloy 2	2.0		0.5	†0.5	*11.1	18.7	2.02
Sicromo 2	2.0		0.5	1.25	*11.5	19.4	2.10
Sicromo 2½	2.5		0.5	0.75	*12.1	20.4	2.2
Sicromo 3	3.0		0.5	1.25	*13.0	21.9	2.37
Croloy 3	3.0		1.0	†0.5	*13.4	22.6	2.44
4-6 chrome moly	5.0		0.5	0.2	*17.4	29.4	3.18
4-6 chrome moly silicon	5.0		0.5	1.5	*19.2	32.4	3.5
Croloy 9	9.0		1.5		*43.5	73.5	7.95
18-8 chrome nickel	18.0	8.0			*59.0	99.5	10.75
BARS OR STRUCTURALS							
Carbon steel					2.44	3.8	1.0
Type 501	5.0			†1.0	9.0	15.2	4.0
Type 502	5.0			†1.0	10.0	16.9	4.45
Type 405 Al	12.5			†1.0	22.5	38.0	10.0
Type 410	12.5			†1.0	21.0	35.5	9.35
Type 302	18.0	8.5		†1.0	27.0	45.5	12.0
Type 304	19.0	10.5		†1.0	28.0	47.2	12.4
Type 309	23.0	13.5		†1.0	40.5	67.5	17.8
Type 310	25.0	20.5		†1.0	55.0	93.0	24.4
Type 316	17.0	12.0	2.5	†1.0	45.0	76.0	20.0
Type 317	19.0	12.5	3.5	†1.0	56.0	94.5	24.9
Type 321 Ti	18.0	9.5		†1.0	32.5	55.0	14.5
Type 347 Cb	18.0	10.5		†1.0	37.0	62.5	16.4
Type 403	12.0			†1.0	24.0	40.5	10.7
Type 406 Al	13.0			†1.0	26.0	44.0	11.6
Type 414	12.0	†2.0		†1.0	21.0	35.5	9.35
Type 420	13.0			†1.0	27.0	45.5	12.0
Type 430	16.0			†1.0	21.5	36.3	9.55
Type 431	16.0	†2.0		†1.0	21.5	36.3	9.55
Type 440	16.0			†1.0	27.0	45.5	12.0
Type 441	16.0	†2.0		†1.0	27.0	45.5	12.0
Type 442	20.5			†1.0	25.0	42.2	11.1
Type 446	26.5			†1.0	31.0	52.4	13.8
Type 301	17.0	8.0		†1.0	27.0	45.7	12.0
Type 303	18.5	9.0	†0.6	†1.0	29.0	49.0	12.9
Type 308	20.5	11.0		†1.0	32.5	54.9	14.4
Type 311	20.0	25.0		†1.0	55.0	93.0	24.4
Type 312	29.0	9.0		†1.0	40.5	68.5	18.0
Type 315 Cu	18.0	8.0	1.25	†1.0	40.5	68.5	18.0
Type 325 Cu	8.5	21.0		†1.0	29.0	49.0	12.9
Type 327	27.5	4.0		†1.0	35.0	59.1	15.6
Type 329	27.5	4.0	1.25	†1.0	40.5	68.5	18.0
Type 330	15.0	34.5		†1.0	55.0	93.0	24.4

*Converted from 1937 by a factor of 1.086. †Maximum.

What to Look for when you buy CELLAR CONTROL GATES



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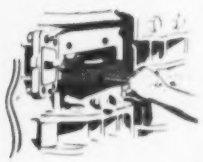

Rams must be changed frequently to meet requirements of varying pipe sizes as wells are drilled. In Shaffer Hydraulic Gates you simply open two doors in the side of the body, slide out the ram assembly, change rams, slide the assembly back in place and bolt the doors. **And complete ram changes can be made with equal ease whether the pipe is in or out of the hole!**

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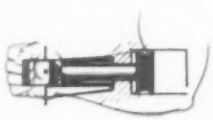
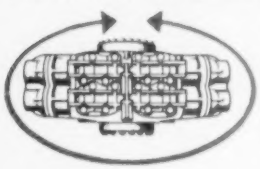


Note how Shaffer Hydraulic Gates have no complicated hook-ups or secondary connections between rams and operating cylinders. Operating pistons are **directly behind** the rams for direct fool-proof drive, fewer parts, positive simplicity!

Look for ENCLOSED DESIGN!



There are no exposed moving parts in Shaffer Hydraulic Cellar Control Gates. All operating members are enclosed within the gate body—protected from corrosive muds, from jamming by loose timbers, from abrasive grit and sand!

Look for MUD-FREE DRAINAGE!

No detrimental mud accumulations can interfere with free ram travel in Shaffer Gates because the rams move on high narrow guide ribs above the steeply-sloped ram compartment bottoms. Mud and sand quickly drain back into well—rams are always ready for use.

These and many other features make Shaffer Hydraulic Cellar Control Gates the outstanding choice of leading operators. Compare, point-by-point, and you'll see why! Your nearest Shaffer representative will gladly supply complete details on Shaffer equipment. Or write Direct!

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30 years OF OIL TOOL LEADERSHIP

by
Walter C. Richards*

How to Make Sure Your Slings Are Safe—1

IT is essential for the sake of safety that wire-rope slings of sufficient strength be selected. In making the selection, where two or more legs are involved, consideration must be given to the important fact that the stress in a sling varies with the angle at which the legs are used.

The selection is based on loads that are approximately symmetrical and in balance, and legs that are of equal length. If a sling is to be calculated for an unbalanced load—where one leg will handle a greater weight than the other—this must be clearly indicated, and a sketch should be submitted to the supplier showing the location of the center of gravity.

In Fig. 2, rated capacities for bridle slings are shown with both legs vertical. These are usually attached to a spreader bar and used to lift locomotive and car bodies. The typical bridle sling is seldom used with both legs vertical. They are generally spread apart as shown.

If the legs are to be vertical, the full-rated capacity of the sum of the two ropes is available. When the legs are spread at an angle, the allowable rated capacity will decrease as the angle increases.

How to Calculate Rated Capacities on Slings

For a sling of given rope diameter the rated capacity at 60°, 90°, and 120° would be calculated by using charts showing the percentages of rated capacity. (Two such charts will be in the next installment.)

*Chief engineer, A. Leschen & Sons Rope Co.

Rope Diameter in Inches	In Tons of 2000 Pounds				
	Vertical Hitch	Anchor Hitch	Basket Hitch — Position of Legs		
			Vertical	60°	45°
6x19 Fiber Core					
⅝	9	7	1 8	1 5	1 2
½	1 5	1 2	3	2 6	2 1
⅝	2 3	1 7	4 6	4	3 2
¾	3 4	2 8	6 8	5 9	4 8
⅞	4 6	3 8	9 2	7 9	6 5
1	6	4 9	12	10 4	8 5
1⅛	7 5	6 2	15	13	10 6
6x37 Fiber Core					
1¼	8 7	7 2	17 4	15	12 3
1⅜	10 6	8 7	21 2	18 3	15
1½	12 6	10 4	25 2	21 8	17 8
1⅝	14 7	12 1	29 4	25 4	20 8
1¾	17	14 1	34	29 4	24
1⅞	19 5	16 1	39	33 8	27 6
2	22 1	18 3	44 2	38 3	31 2

Note 1—The safe loads shown in this table provide a factor of safety—varying with the rope diameters—of from six to seven.

Note 2—The table above is based on an average diminishing splicing efficiency of from 95% to 75%.

Note 3—For slings with wire rope core add 7½% to the safe loads of table above.

Fig. 1.

The degree of spread may be designated by the included angle at the hook, or by the angles made by the legs with a horizontal plane.

In the case of a sling with equal-length legs, spread at an angle of 60° at the top, the legs would also make an angle of 60° with the horizontal. If the angle at the top were 90°, the legs would make an angle of 45° with the horizontal. The relationship is based on the law that the sum of the angles of a triangle is 180°.

Rope Diameter in Inches	In Tons of 2000 Pounds								
	Two Legs			Three Legs			Four Legs		
	Vert.	60°	45°	Vert.	60°	45°	Vert.	60°	45°
6x19 Fiber Core									
⅝	1 8	1 5	1 2	2 7	2 3	1 9	3 6	3 1	2 5
½	3	2 6	2 1	4 5	3 9	3 2	6	5 2	4 2
⅝	4 6	4	3 2	6 9	5 9	4 8	9 2	7 9	6 5
¾	6 8	5 9	4 8	10 2	8 8	7 2	13 6	11 8	9 6
⅞	9 2	7 9	6 5	13 8	11 9	9 7	18 4	15 9	13
1	12	10 4	8 5	18	15 6	12 7	24	20 8	16 9
1⅛	15	13	10 6	22 5	19 5	15 9	30	26	21 2
6x37 Fiber Core									
1¼	17 4	15	12 3	26 1	22 6	18 4	34 8	30 2	24 6
1⅜	21 2	18 3	15	31 8	27 5	22 4	42 4	36 7	30
1½	25 2	21 8	17 8	37 8	32 7	26 7	50 4	43 6	35 6
1⅝	29 4	25 4	20 8	44 1	38 2	31 2	58 8	51	41 6
1¾	34	29 4	24	51	44 2	36	68	58 8	48
1⅞	39	33 8	27 6	58 5	50 6	41 3	78	67 5	55 1
2	44 2	38 3	31 2	66 3	57 4	46 8	88 4	76 5	62 4

Note 1—The safe loads shown in this table provide a factor of safety—varying with the rope diameters—of from six to seven.

Note 2—The table above is based on an average diminishing splicing efficiency of from 95% to 75%.

Note 3—For slings with wire rope core add 7½% to the safe loads of table above.

Fig. 2.

Dimensions in Inches

Diam. of Each of the Six Rope Parts	In Tons of 2000 Pounds									*Single Part Round Wire Ropes with Fiber Cores having Approx. Equal Strength
	One Leg	Two Legs			Three Legs			Four Legs		
	Vertical	Vertical	60°	45°	Vertical	60°	45°	Vertical	60°	45°	
⅛	6	1 2	1	8	1 8	1 5	1 2	2 4	2	1 6	⅝-⅝
5/16	1 3	2 6	2 3	1 9	3 9	3 4	2 8	5 2	4 6	3 8	⅝-⅞
¼	2 4	4 9	4 2	3 4	7 3	6 3	5 1	9 8	8 4	6 8	½-⅝
3/8	3 8	7 5	6 5	5 3	11 2	9 7	7 9	15	13	10 6	⅝
7/16	5 3	10 6	9 2	7 5	15 9	13 8	11 2	21 2	18 4	15	⅞-1
½	7 1	14 2	12 3	10	21 3	18 4	15	28 4	24 6	20	1-1¼
9/16	9 3	18 5	16	13 1	27 8	24	19 6	37	32	26 2	1¼-1½
⅝	11 5	23	20	16 5	34 5	30	24 7	46	40	33	1½-1⅞
11/16	14 5	29	25	21	43 5	37	31 5	58	50	42	1⅞-1¾
¾	21	42	36	30	63	54	45	84	72	60	1¾-2
⅞	28	56	49	40	84	73 5	60	112	98	80	2-2¼
1	36	72	62	51	108	93	76 5	144	124	102	2¼-2½
1⅛	45	90	78	64	135	117	96	180	156	128	2½

*As these are "approximate" figures, we recommend a careful study of all conditions before deciding upon the size sling to be used.

Fig. 3.

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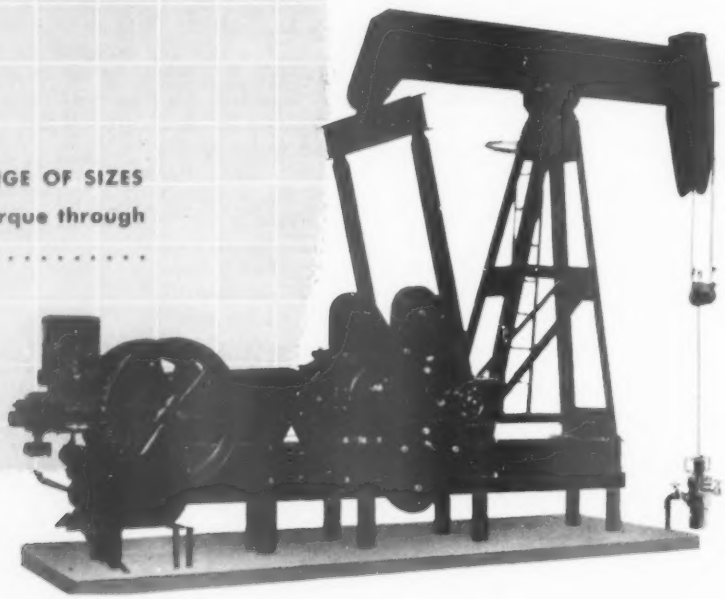

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COURTESY • SERVICE • DEPENDABILITY

Making Tests for Flashing Liquids

by Glenn F. Brockett* and Charles F. King*

THE capacity of control valves handling liquids at inlet and outlet temperatures and pressures that would indicate liquid phase has generally been determined from the fundamental law of fluid flow,

$$V = \sqrt{2gh}.$$

In most applications, calculations based on this fundamental law gives accurate results. It is, however, possible to have conditions of temperature and pressure such that the deviation from this law is too great to be disregarded.

There has been no generally accepted method of determining control-valve capacity when thermodynamic considerations indicate a mixture of steam and water at the outlet of the valve.

"Heat balance" method . . . This is based on the assumption that a certain per cent of the vapor existing downstream from the control valve was flashed in the body, and the port area is made sufficiently large to pass the liquid, plus the arbitrarily chosen percentage of flashed vapor. Different individuals have assumed the percentage of vapor flashed in the valve body to be between 50 and 100 per cent of the total existing downstream. Another method that has been recommended is to make the valve one size larger if pressure and temperature indicate flashing in the body. These methods are based on guesswork and often lead to incorrect sizing.

In order to obtain test data from which an accurate method of sizing control valves handling hot water could be evolved, Fisher Governor Co. has run some laboratory tests that lead to some interesting conclusions.

Test equipment . . . Equipment used in running the tests is illustrated schematically in Fig. 1. Water was pumped into two 1,000-gal. storage tanks, indicated on the left of the illustration, and heated to various desired temperatures by the injection of live steam into the bottom of the tanks. Pressure was controlled by introducing compressed air near the top of the tanks. By this method it was possible to obtain pressures ranging from nearly atmospheric to 200 psia. and temperatures from 70° to 350° F.

Hot water from both storage tanks was piped into a single 4-in. metering test line. The test line contained straightening vanes, orifice flanges, hand-operated valve, the test valve, an expansion joint, a hand valve, and a separation tank, in that order. From the separation tank, steam was exhausted to the roof, and water was piped to the sump, from which the pump took suction.

Pressure and temperature measurements were taken in the storage tank and at various points along the meter run, as indicated by the encircled "P" and "T" designations. Temperature measurements were made with Iron-Constantan thermocouples and recorded on a 12-point high-speed recording potentiometer. Differential pressures up to 25 psi. were measured with differential measuring manometers, and static pressures were measured with bourdon-tube-type test gages.

During a test run, the static pressure of the water in the metering section of the test line was always maintained high enough to prevent flashing at the orifice plate. The test-valve inlet pressure was controlled by means of the hand valve located between the orifice plate and the test valve. The hand valve located downstream from the control valve was used to control the differential pressure.

All piping upstream from the test valve was 4-in. Schedule 40, and downstream from the test valve was 8-in. Schedule 60. Control valves ranging in size from 1 to 3 in. were tested and were installed in the test line with swages.

Angle bodies were tested in a similar arrangement, except for the piping change necessary for their installation.

Although we were primarily interested in studying the flow of water in the liquid state at the control valve inlet, we were able to obtain some data with a water-steam mixture and with all steam at the inlet.

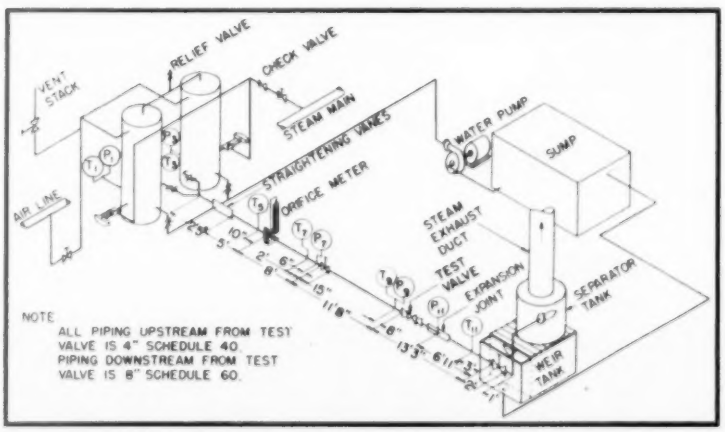

Fig. 1—Arrangement of test equipment.

*Fisher Governor Co. Presented at symposium on Instrumentation for the Process Industries, A. & M. College of Texas, 1953.

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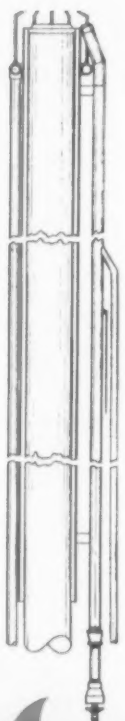

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Turbo-Engine Synthetic Lubes

THE need for synthetic lubricants in the modern jet engine is a result of the higher power levels now being reached. Entirely new lubrication problems have arisen with the newer jet-engine designs. Highly loaded gears and bearings must be lubricated at speeds as high as 10,000 r.p.m. In addition, as shown in Fig. 1, two of the main bearings supporting the turbine must be located near the actual combustion zone. In the latest jet engines the temperature level at the rear bearing may exceed 450° F. On the other hand, at high altitudes and in Arctic climates, temperatures in the range of —65° F. may be encountered in oil systems of engines during starting. Therefore, the oil for the high-power jet engine has difficult lubrication jobs to do, and it must be able to do them at both ends of an extremely wide temperature range.

Performance with synthetic (ester-type) jet-engine lubricants, has been reported *(The Oil and Gas Journal, March 2, 1953, page 76)*. This lubricant, developed by Standard Oil Development Co. and its affiliated research laboratories in England, has now operated in engines on the ground and in flight for well over 10,000 test hours, equivalent to over 6 million engine-miles of flying. This synthetic oil is the first product approved under the U. S. Military Specification MIL-L-7808 for jet-engine lubricants.

The Standard Oil Development synthetic oil is more resistant to decomposition and formation of coke-like deposits than are the jet-engine mineral oils presently used. This is an extremely important property because decomposition and coking are promoted by the high temperatures encountered in higher power engines. (Fig. 2.) There is no doubt that the engines of tomorrow, operating at even higher temperatures, will require the development of still better synthetic lubricants.

The raw materials for producing these esters are obtainable from several sources, including petroleum. However, the present jet-engine oil is not derived entirely from petroleum-source chemicals. This product is recognized as being merely the first step in the evolution of synthetic jet-engine oils. Development of equivalent or better synthetics from petroleum-source chemicals is not only considered possible—it is believed to be eminently desirable, since petroleum-derived raw materials are felt to offer the widest potential availability and lowest cost possible for this type of product.

The recently designed jet engines are compact in size and yet substantially more powerful than the jets and largest piston engines now flying regularly. The largest conventional piston engine weighs about 3,700 lb. and produces about 3,500 hp. Several present-day jet engines, weighing about 3,000 lb., can deliver the equivalent of 9,000-10,000 hp. when flying at modern high speeds. This comparison indicates the advances made in the last several years. However, now undergoing testing are still more powerful, compact engines. But these more recent power-packed jet engines cannot be properly lubricated with conventional petroleum oils, as are their predecessors.

The advanced-design jet engines and the synthetic oil required to lubricate them are believed essential to the continued building of superior military aircraft, and ultimately they will make possible fast, safe, and comfortable commercial jet air travel. Already several of the latest jet engines are scheduled to power a number of strategically important aircraft. A prime example is the all-jet, long-range Boeing YB-52 bomber, with Pratt & Whitney Aircraft J-57 engines. The S.O.D. synthetic oil was used during the testing and development of the J-57 engine, and is an approved lubricant for this latest design power plant. Most other high-power jet engines, some already being employed in experimental or prototype aircraft, also require a synthetic lubricant of this type.

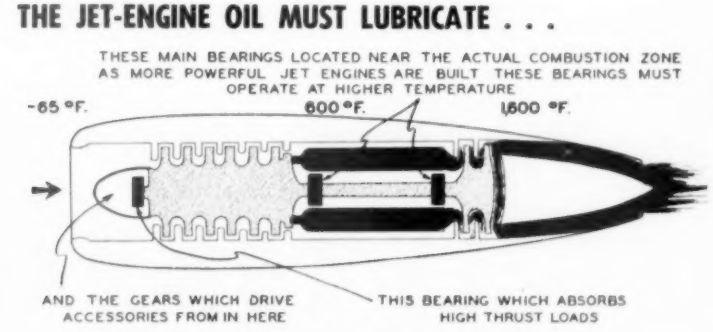

THE JET-ENGINE OIL MUST LUBRICATE . . .
THESE MAIN BEARINGS LOCATED NEAR THE ACTUAL COMBUSTION ZONE AS MORE POWERFUL JET ENGINES ARE BUILT. THESE BEARINGS MUST OPERATE AT HIGHER TEMPERATURE
-65 °F.
600 °F.
1,600 °F.
AND THE GEARS WHICH DRIVE ACCESSORIES FROM IN HERE
THIS BEARING WHICH ABSORBS HIGH THRUST LOADS

Fig. 1—Critical points of lubrication in the modern jet engine.

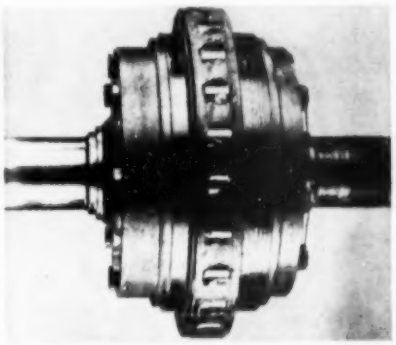
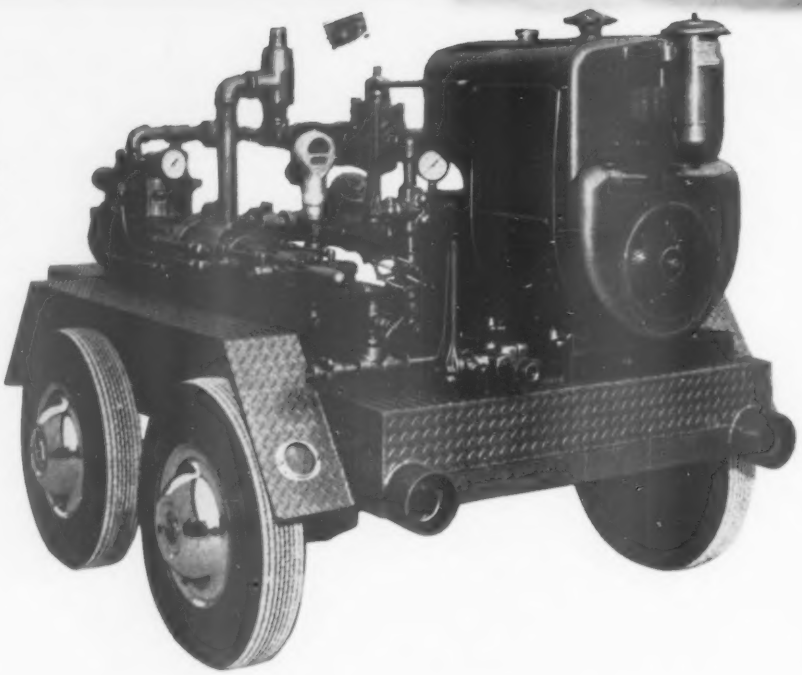


Fig. 2—This bearing from a test rig shows the coke-like deposits which a lubricant can produce in high-temperature zones of modern jet engines.

SAVE on your PULLING JOBS



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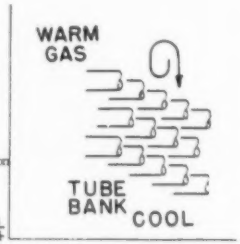
h_f HEAT TRANSFER

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of BANK of COOL TUBES and a WARM GAS



Position of tubes: Horizontal

Gas Movement: Natural Convection

EQUATION:

$$h_f = 0.47 \frac{k}{D_o}\left[\frac{D_o^3 \rho^2 \beta g \Delta t}{\mu^2} \cdot \frac{C_p \mu}{k}\right]^{\frac{1}{4}}$$

TERMINOLOGY:

h_f - Film coefficient of heat transfer, BTU/hr. sq. ft. °F.

k - Thermal conductivity of gas at t_f, BTU/hr. ft.^{2} °F./ft.

D_o - Outside diameter of tube, ft.

ρ - Density of gas at t_f, lb./cu. ft.

g - Acceleration of gravity. 4.17×10^8 ft./hr.^{2}

β - Coefficient of volumetric expansion of gas at t_f: for ideal gas is equal to $1/°R$.

Δt - Temperature difference between tubes and gas, °F.

μ - Viscosity of gas at t_f, lb./ft. hr.

C_p - Specific heat of gas at constant pressure, BTU/lb. °F.

t_f - Film temperature, assumed as arithmetic average of tube temperature and bulk gas temperature, °F.

LIMITATIONS: Tubes should be at least one diameter apart. Tubes should be at least several diameters from bottom of vessel.

Data is erratic and results are likely to not be too accurate.

SOURCES OF DATA: For physical constants for use in above equation see Chemical Engineers' Handbook - J. H. Perry (1948).

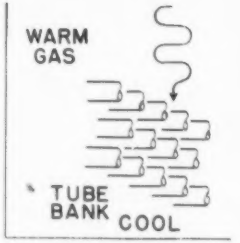
for ρ -- see pp. 130-148, 175-195, 1583.
μ -- see pp. 370-374, 1198, 1696.
β -- see pp. 200-202.
k -- see pp. 459-461, 1303, 1697.
C -- see pp. 225-235, 297, 1588, 1696.

REFERENCES:

1. Process Heat Transfer, Kern, pp. 216-217.
2. Heat Transmission, 2nd Edition, W. H. McAdams, pp. 255-257.
3. T. H. Chilton and others, Trans. A.I.Ch.E. Petroleum Mech. Eng., 38, p. 5 (1933).

L 1 a

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of BANK of COOL TUBES and a WARM GAS



Tube Position: Horizontal

Tube Arrangement: Staggered

Gas Movement: Turbulent

Direction of Movement: Normal to tube.

EQUATION:

$$h_f = 0.33 \frac{k}{D_o}\left[\frac{D_o V_{max} \rho}{\mu}\right]^{0.6}\left[\frac{C_p \mu}{k}\right]^{0.33}$$

TERMINOLOGY:

h_f - Coefficient of heat transfer, BTU/ft.^{2} hr. °F.

D_o - Outside diameter of tube, ft.

k - Thermal conductivity of gas at t_f, BTU/ft. hr. °F.

V_{max} - Maximum velocity of gas through free space between front bank of tubes, ft./hr.

ρ - Density of gas at t_f, lbs./ft.^{3}

μ - Absolute viscosity of gas at t_f, lbs./hr. ft.

C_p - Specific heat of gas at t_f, BTU/lb.°F. at constant pressure.

t_f - Film temperature = 1/2 sum of outer wall temperature and main body temperature.

LIMITATIONS: The Reynolds number $(DV_{max}\rho/\mu)$ must be over 2000.

Equation above for data taken on bank of tubes 10 rows deep. For shallower tube banks $h_{f(corr)} = h_{f(calc)} \times$ correction factor as follows:

Rows	Factor	Rows	Factor	Rows	Factor
2	0.73	3	0.82	4	0.88
5	0.91	6	0.94	7	0.96
8	0.98	9	0.99	10	1.0

h_f, calculated for banks of tubes in baffled heat exchangers should be multiplied by 0.6 to provide for leakage around the baffles.

SIMPLIFIED EQUATION:

$$h_f = 0.133 \frac{C_p (V_{max}\rho)^{0.6}}{D_o^{0.4}}$$

PHYSICAL CONSTANTS: See Chemical Engineers' Handbook - J. H. Perry (1948).

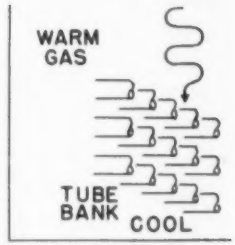
for ρ -- see pp. 130-148, 175-195, 1583.
μ -- see pp. 370-374, 1198, 1696.
k -- see pp. 459-461, 1303, 1697.
C -- see pp. 225-235, 297, 1588, 1696.

REFERENCES:

1. Heat Transmission, William H. McAdams, pp. 228-229.
2. Elements of Heat Transfer and Insulation, Jakob & Hawkins, p. 115.
3. Introduction to the Transfer of Heat & Mass, Eckert, pp. 144-145.

L 1 c (1)

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of BANK of COOL TUBES and a WARM GAS



Tube Position: Horizontal

Tube Arrangement: In line

Gas Movement: Turbulent

Direction of Movement: Normal to tubes

EQUATION:

$$h_f = 0.26 \frac{k}{D_o}\left[\frac{D_o V_{max} \rho}{\mu}\right]^{0.6}\left[\frac{C_p \mu}{k}\right]^{0.33}$$

TERMINOLOGY:

h_f - Coefficient of heat transfer, BTU/ft.^{2} hr. °F.

D_o - Outside diameter of tube, ft.

k - Thermal conductivity of gas at t_f, BTU/ft. hr. °F.

V_{max} - Maximum velocity of gas through free space between front bank of tubes, ft./hr.

ρ - Density of gas at t_f, lbs./ft.^{3}

μ - Absolute viscosity of gas at t_f, lbs./hr. ft.

C_p - Specific heat of gas at t_f, BTU/lb.°F.

t_f - Film temperature = 1/2 sum of outer wall temperature and main body temperature.

LIMITATIONS: Reynolds number $(DV_{max}\rho/\mu)$ must be over 2000.

Equation above for data taken on bank of tubes 10 rows deep. For shallower tube banks $h_{f(corr)} = h_{f(calc)} \times$ correction factor as follows:

Rows	Factor	Rows	Factor	Rows	Factor	Rows	Factor
1	0.64	2	0.80	3	0.87	4	0.90
5	0.92	6	0.94	7	0.96	8	0.98
9	0.99	10	1.0				

SIMPLIFIED EQUATION:

$$h_f = 0.106 \frac{C_p (V_{max}\rho)^{0.6}}{D^{0.4}}$$

PHYSICAL CONSTANTS:

Page references in the Chemical Engineers' Handbook, J. H. Perry (1948) are as follows:

for ρ -- 130-148, 175-195, 1583.
μ -- 370-374, 1198, 1696.
k -- 459-461, 1303, 1697.
C -- 225-235, 297, 1588, 1696.

REFERENCES:

1. Heat Transmission, William H. McAdams, pp. 228-229.
2. Elements of Heat Transfer and Insulation, Jakob & Hawkins, p. 115.
3. Introduction to the Transfer of Heat & Mass, Eckert, pp. 114 -140.

L 1 c (2)

lift loads from any depth.....

WITH THE TYPE 'L'

Finest Tubing Swab Cup Made For Lifting Heavy or Light Loads

When you're swabbing from any depth or want to unload the well completely, you can do a better, more efficient job with the Guiberson Type L on the regular Guiberson K Swab. This unbeatable combination drops fast and seals perfectly for the lift — and has the flexibility and durability to do a top-notch job. Capable of lifting heavy loads, this versatile cup will also lift the last light loads from the bottom of the well. The L lifts *full* loads, not just part way but all the way to the surface, slipping by collars just as though they weren't there. The next time you need a general purpose swab cup, get the Type L. Look for it at any supply store, packaged in pairs in the brilliant blue box.

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ESTABLISHED 1919 • DALLAS, TEXAS, U. S. A.
Sold By Leading Oil Field Supply Stores Everywhere

EQUIPMENT MEN . . . in the News

Dahlberg Elected to Board By American Pipe & Steel

C. B. DAHLBERG

Carl B. Dahlberg, formerly sales manager of American Pipe & Steel Corp. of Alhambra, Calif., has been elected to the board of directors and made vice president in charge of sales, according to an announcement by Jack Lane, president and general manager.

Also elected to the board is L. E. Howard, Jr., formerly with Bank of America. He will be secretary-treasurer of the company.

R. A. J. ENGLISH

HOWARD

Rear Adm. R. A. J. English, U.S.N. (retired), was elected vice president in charge of production and engineering administration. A graduate of U. S. Naval Academy and the Naval War College, he earned his Master of Science degree at Columbia University.

This strengthening of management is a step in the company's program of expansion, which contemplates a merger that would further diversify the corporation's products, markets, and facilities. Manufacturing plants are maintained at Alhambra and Hemet, Calif., and negotiations are in progress for additional facilities at Blythe, Calif.

The company offers a complete line of oil-field production equipment—separators, treaters, heaters, and tanks, and holds the exclusive California license for the manufacture and sale of products of National Tank Co., Tulsa.

Mid-Continent Supply to Distribute Regan Products

Tom Regan, president of Regan Forge & Engineering Co., San Pedro, Calif., recently announced the appointment of Mid-Continent Supply Co., of Fort Worth, as exclusive Mid-Continent and export distributors of all Regan products. The California petroleum areas will continue to be handled out of the home plant and Bakersfield service branch. Plans are being made by the company to release several new and improved products by early fall, according to Regan.

Perrault Equipment Adds Vallejo to Sales Division

F. VALLEJO

R. E. (Bob) Shackleford, general manager of Perrault Equipment Co. in Tulsa, has announced that Fred Vallejo, formerly with Bechtel Corp. in San Francisco, has joined Perrault in the sales division.

Vallejo has been in the pipe-line business since 1949. In addition to working for Bechtel, he was in sales work for Friedman Equipment Co. in Bridgeport, Conn. His work for Perrault, suppliers of equipment and materials for pipe-line contractors, will cover West Texas, northern Oklahoma, Colorado, Nebraska, Kansas, and Missouri.

Texas Tool Appoints Jarvis General Sales Manager

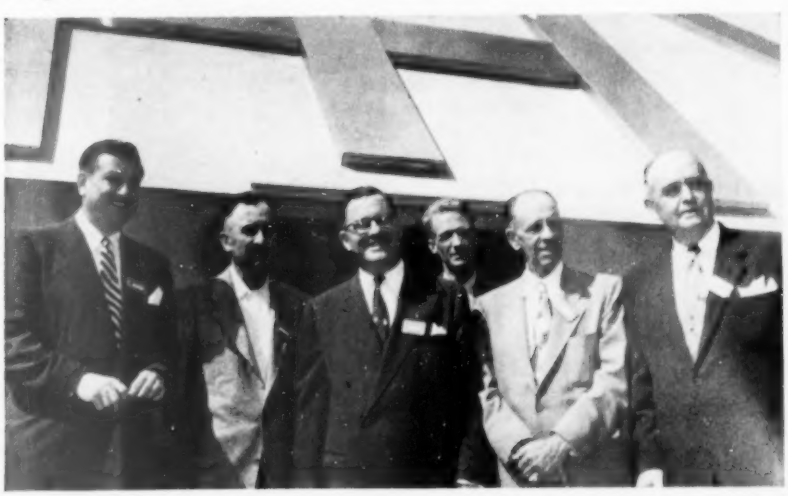
R. JARIVS

Bill Baker, president of Texas Tool & Machine Co., Houston, has announced the appointment of Robert Jarvis as general sales manager.

Jarvis has been in the oil business for many years and has just returned from Venezuela where he owned and operated his own oil-well service company. Before going to South America, Jarvis was a tool design engineer. He has also traveled extensively in the United States as a sales engineer.

Jarvis received his training at U.C.-L.A. in California, and worked in tool design and plant engineering following his graduation.

Hughes Tool Sales Personnel Meet at Recent I.P.E.



This group of Hughes Tool Co. sales department personnel were photographed at one of four entrances to Hughes Tool building at the recent International Petroleum Exposition in Tulsa. Left to right: H. M. Kelly, special sales representative; R. L. Long, manager of southern region; M. E. Montrose, vice president, sales; G. J. Meyer, advertising manager; W. L. Hunter, manager of northern region, and W. H. Siems, general sales manager.

Graver Tank Establishes New Plant at Odessa, Tex.

J. E. Swanson, executive vice president, Graver Tank & Manufacturing Co., Inc., East Chicago, Ind., has announced the establishment of a new plant at Odessa, Tex.

Situated on a 7-acre site, the new installation will serve as an important adjunct to Graver's lease-tank fabricat-

the only hose of its kind in the oil fields

Thermoid TRIOFLEX Rotary Hose

light . . . flexible . . . coils easily . . . resists kinking

Designed for portable drilling units, work-over rigs and seismographic work, Trioflex is a worthy companion to Thermoid Powerflex—the No. 1 Rotary Hose in the field.

- Synthetic rubber tube resists oil and abrasion.
- Braided steel wire reinforcement adds strength and flexibility.
- Tough, specially compounded cover resists abrasion and aging.
- Pressed-on couplings are anchored securely for the life of the hose.
- Every length pre-tested to 2000 psi.

Furnished in three sizes:
2″—with 2″ male couplings, API threads
2½″—with 2½″ male couplings, API threads
3″—with 3″ male couplings, API threads

Get Trioflex from your supply house, or the nearest Thermoid warehouse.

Thermoid Industrial Rubber Products — Quality — Service

Mid-continent Office and Warehouse
Houston, Texas

California Office and Warehouse
Los Angeles

SEE OUR CATALOG IN THE COMPOSITE CATALOG

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Wire Line Turn Backs • No-Wip Line Savers • Stuffing Box Rings • All Types of Hose • Molded Specialties • Brake Blocks

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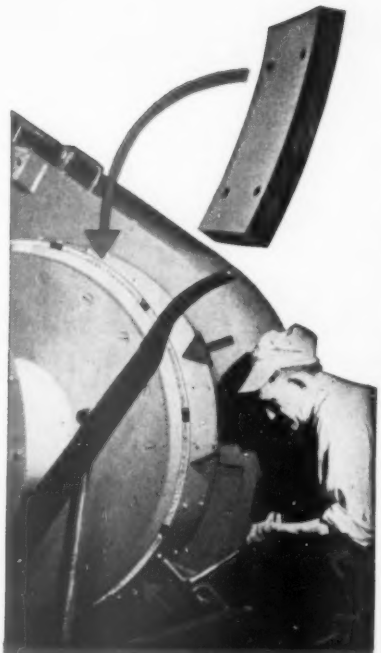


for round the clock operation choose Thermoid

Emsco Drawworks represent the most advanced engineering design for continuous drilling. These units operate 24 hours a day, seven days a week, under highly severe conditions.

Small wonder that Thermoid TX Oil Field Woven Brake Blocks are original equipment on Emsco Drawworks. Thermoid makes Brake Blocks that provide reliable performance and uniform friction. Long wear cuts down change-overs which cost valuable operating time.

For a half century, Thermoid has been making friction materials for a wide variety of industries: petroleum, automotive, transportation, agriculture and others. This experience, plus close attention to individual manufacturers' needs, is your assurance of safer, longer brake life . . . less maintenance cost . . . with Thermoid TX Oil Field Woven Brake Blocks.

Mid-continent Offices and Warehouse
Houston, Texas

Thermoid

Thermoid Company, Trenton, N. J.

Macco Corp. Remodels and Enlarges California Offices

Macco Corp. has recently completed remodeling and enlarging its main offices at Paramount, Calif., executive headquarters for the company's construction, refinery, rig building, pipe line, drilling fluid, and lumber divisions. The building was extended an additional 35 ft. to provide larger engineering quarters. The foyer was enlarged and redecorated, and 10 new offices were added to increase the total office floor space to more than 17,000 sq. ft.

ing facilities at the company's plant at Sand Springs, Okla. Extensive warehouse space at Odessa will permit storing of well-head equipment manufactured at Sand Springs, and shop-built lease tanks of 500-bbl. capacities fabricated at Odessa. By serving as an immediate base of supply for this equipment, the new plant will facilitate distribution of Graver products throughout the southwest.

Detroit Diesel Appoints Howell to New Sales Post

C. HOWELL

Detroit Diesel Engine Division of General Motors has announced the appointment of Charles Howell as assistant to A. F. Campbell, the division's manager of engine sales to the petroleum industry in Tulsa.

Howell joined Detroit Diesel in 1948, and prior to his present assignment served as factory sales engineer to the division's West Coast distributors. He succeeds E. J. VanDyk who is being transferred to the home office in Detroit as an engineering consultant to the sales department.

Ideco Announces Sale Of Pumping Unit Line

Geo. W. (Jack) Walton, vice president of International Derrick & Equipment Co., one of the Dresser Industries, has announced the sale of IDECO pumping-unit line to Alten Foundry & Machine Works, of Lancaster, Ohio.

Under terms of the sale, Alten will continue the manufacture, sale, and service of IDECO pumping units, and will also manufacture all spare parts for both the Alten-built IDECO units, and units built by IDECO prior to the sale to Alten. IDECO pumping-unit users are being advised to order their spare-parts requirements directly from Alten at Lancaster.

Walton further stated that the sale of the pumping-unit business to Alten is the final step in IDECO's over-all program to confine its operations to the manufacture of equipment for drilling, workover, and servicing operations.

Jones Makes Trip to Venezuela for Chiksan

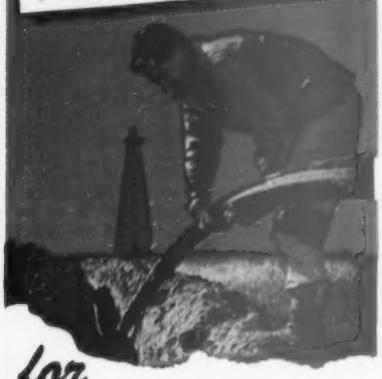
Chiksan Co. has sent Robert T. Jones, field engineer, from the Brea, Calif., plant to San Jose, Guatemala, to work with Esso Standard Oil Co. on its undersea unloading lines which discharge butane, propane, and other petroleum products from tankers to a bulk station on shore.

Jones will render assistance and advice on the use of Chiksan ball-bearing swivel joints on these submerged lines. The use of Chiksan joints in undersea service is increasing throughout Central and South America, the company reports.

Jones' trip is part of Chiksan's ex-

Corrosion Proof

Cres LINE-BR
PLASTIC LINE PIPE



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- Lead Lines
- Flow Lines
- Gathering Lines
- Salt Water Disposal Lines
- Return Water Flooding Lines

Sour crudes, salt water, etc. "won't touch" corrosion-proof, Cresline-BR all-plastic line pipe.

Its smooth wall gives up to 40% better flow . . . eliminates paraffin build-up. Light weight easy-to-handle Cresline-BR has chemical weld joints to speed laying.

Made in SWP sizes to standards established by Thermoplastic Pipe Division of the Society of Plastics Industry.

Over a million feet of Cresline-BR Plastic line pipe is now giving satisfactory service.

WRITE FOR NEW LITERATURE
and name of nearest distributor

CRESCENT PLASTICS, Inc.
955 Diamond Avenue • Evansville, Indiana
Member: Thermoplastic Pipe Div. of S. P. I.

100% Virgin Stock
Cellulose Acetate Butyrate

panding field service to customers both in the United States and abroad.

Harbison-Fischer Appoints Arkansas Representative

Harbison-Fischer Manufacturing Co., Fort Worth, has appointed Barney Horrigan as its representative in Magnolia, Ark.

Horrigan started in oil almost 20 years ago, working the Mid-Continent, Rocky Mountain, and Gulf Coast areas for the old Sinclair-Prairie Oil Co. Prior to joining Harbison-Fischer he was with Kountz-Carter Supply Co. of Big Spring, Tex., as a subsurface equipment salesman.

Harbison-Fischer manufactures and markets a complete line of rod and tubing pumps, balls and seats, and related production equipment for pumping wells.

Walsh Refractories Corp. Elects Hershfield President

Paul L. Hershfield, president of Mississippi Glass Co., has also been elected president of Walsh Refractories Corp., St. Louis, replacing J. L. Crawford, recently resigned. Hershfield continues as chairman of the board of Walsh Co., an office he has held for several years.

A. J. Tomasek, formerly chief engineer, has been promoted to the office of executive vice president of Walsh Refractories.

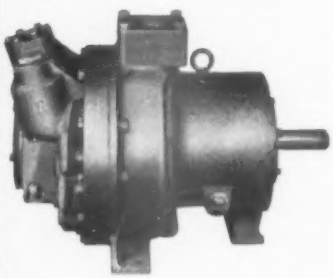
John J. Duggan has been promoted to sales manager, Glass Refractories, and W. K. Schweickhardt, formerly district sales manager, Chicago office, has been promoted to sales manager, General Refractories, with headquarters at St. Louis. Thomas W. Gill has been re-elected secretary and treasurer.

Kraloy Plastic Pipe Co. Appoints Hill & Christopher

Kraloy Plastic Pipe Co., Los Angeles, has appointed Hill & Christopher as its advertising agency, according to Robert C. Raab, executive vice president. Raab reported that increased use of plastic pipe by the nation's industries necessitated broadening the scope of the firm's advertising program.

Kraloy is one of the nation's top producers of noncorrosive plastic pipe for industrial and agricultural use. The firm has recently developed a strong new rigid vinyl pipe for economical use in industrial installations.

For QUALITY
Specify
PYLE-NATIONAL
Turbines
¼ to 120 h.p.



The Pyle-National line of highly efficient impulse type turbines is ideal for prime movers and standby drives on pumps, generators and other equipment in refineries . . . also for drilling site equipment such as shale shakers, pumps, bug blowers, generators, etc.

Since 1897 Pyle-National has manufactured their turbines entirely within their own plant . . . thus assuring positive control of quality and workmanship through all stages of production . . . from raw material to the final testing.

SEND NOW FOR BULLETINS

containing complete information on these small and medium capacity turbines.

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Also available is bulletin on Pyle-National turbo-generators (500 to 15000 watts).

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EXPLOSION PROOF FITTINGS • FLOODLIGHTS

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One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

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Ladish measures the spectrum to verify chemical composition

Metallurgical integrity—is safeguarded at Ladish by unsurpassed laboratory controls. Typical is this advanced electronic direct-reading spectrograph. On this unit as many as 300 determinations have been made in one hour to verify compliance of each mill heat with exacting Ladish specifications and, equally important, to assure the absence of detrimental "tramp" elements. Here is but one indication of the thorough, scientific procedures that assure reliability in every Ladish Controlled Quality fitting.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

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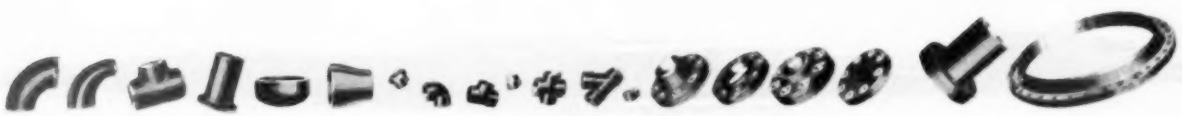
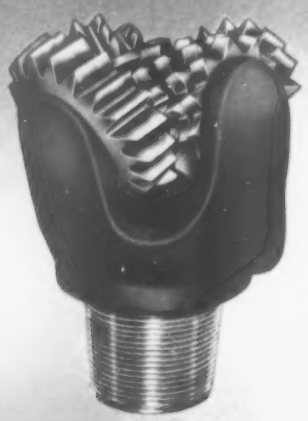


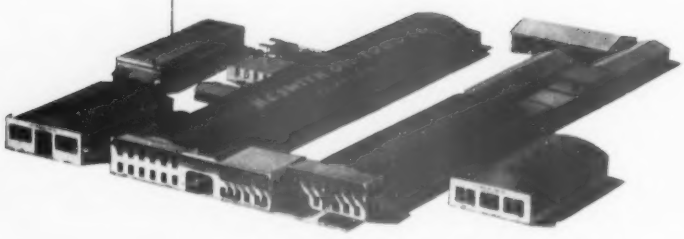
H C Smith

ROCK BITS

THERE ARE NO FINER MADE



There are no better rock bits
—in design, in construction,
in strength, in drilling efficiency—
and **we have the facts to prove it!**



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OIL TOOL CO.

GENERAL OFFICES, EXPORT OFFICES AND PLANT · COMPTON, CALIF. **Branches in all principal oil centers in the United States and Canada**

Among the Drilling Contractors

New Drilling Company To Operate in Israel

Pontiac Petroleum, Ltd., Wichita Falls, Tex., newly formed drilling company, is assembling personnel and equipment and completing arrangements for an exploratory test it will drill for New Continental Oil Co., Ltd., of Calgary, Alta., on a 700,000-acre concession that latter company has in Israel.

The new drilling company is a subsidiary of Pontiac Refining Co., Corpus Christi, Tex., headed by Edwin Singer, president; Herbert M. Singer, vice president; and Saul Singer, treasurer.

Eastern Kentucky Gets First Rotary Operation

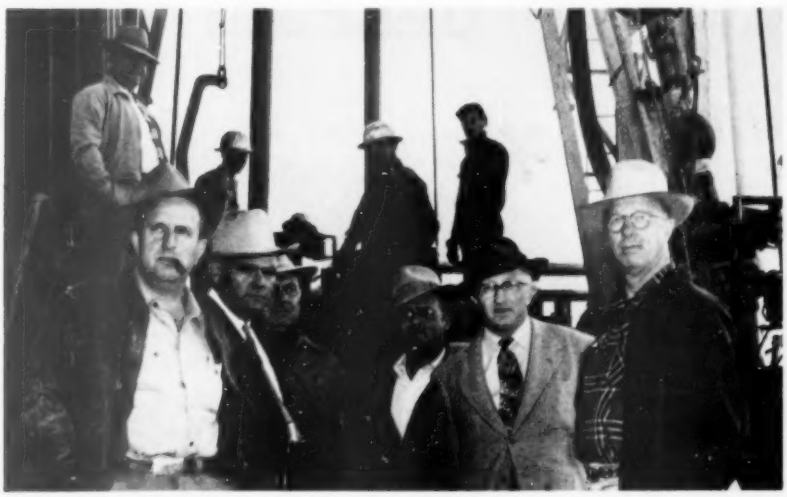
The first rotary rig to operate in the eastern Kentucky portion of the Appalachian area is being moved in by Sanders-Fye Drilling Co. of Olney, Ill. It is under contract to North American Petroleum Co. of Chicago and will be used initially to deepen a wildcat test in Bell County which the latter company drilled to 4,201 ft. with cable tools.

Following the completion of this job, it is proposed to drill another test in the same area from top to bottom with the rig. The deepening job is at North American's 2 R. E. Vial, located in 19-E-72, 12 miles northeast of Pineville. Hole will be carried through the Corniferous section, which was topped at 4,115 ft., and in which the test now is bottomed.

It has been only within the past couple of years that rotary tools have been used in any part of the Appalachian region. Most extensive use of rotary tools in the region so far has been in the development of gas production on the Oriskany sand structure in the Driftwood area of Cameron and Elk counties, Pennsylvania. Rotary drilling was initiated in that area about 1½ years ago by Delta Drilling Co. of Tyler, Tex.

Kemp Drilling Co., Shreveport, has contracted a rig to George S. Engle of Miami, Fla., for a deep wildcat test to be drilled in Ascension Parish, Coastal Louisiana. Location of the test, 1 S. T. Alcus, Jr., in 27-10s-3e, is 3 miles northeast of Burnside and about 3½ miles west of the Sorrento field.

Big "6" Drilling Co. has a contract with Blair & Vreeland of Corpus Christi for a 6,500-ft. wildcat test to be drilled about 1½ miles west of Panna Maria, Karnes County, lower Texas



Visiting the new drilling operations which Clyde Hall Drilling Co. has under way for Pacific Western Oil Corp. on the Belgian Anticline, on the west side of the San Joaquin Valley, California, are, left to right: Carl Browall, general superintendent, drilling and producing departments, Pacific Western Oil Corp.; Clyde Hall, owner Clyde Hall Drilling Co.; Warren Craddock, chief engineer, Pacific Western; Guy Simpson, drilling superintendent for Clyde Hall; W. A. MacMullen, Bethlehem Supply Co.; and Ray Jones, San Joaquin Valley district superintendent, Pacific Western. The operation is 32-30 Midway-McKittrick, first well to be drilled with the new Bethlehem M-58 rig recently acquired by the drilling company.

Insurance against wash-outs

The best insurance against wash-outs is a well sealed joint. You can depend on Bestolife Lead Seal Tool Joint and Casing Compound to give a perfect seal, without seizing or galling.

The Standard of the Oil Country for over 20 years. Unconditionally guaranteed. Sold at supply houses throughout the world. Packed in 1¼, 5, 20 and 50 lb. containers.

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PUT OIL TO WORK *with* SIMPLEX HYDRAULIC JACKS *and* PULLERS

- Pull Bits, Casings, Valve Seats, Bushings, Wheels
- Lift and Skid Rigs, Machinery
- Bend or Straighten Pipe

SIMPLEX Hydraulic Jacks
Single and double pump models from 3 to 100 tons capacity.

SIMPLEX - Jenny Hydraulic Pullers
"Center-Hole". Pulls or pushes. Models 30 — 100 tons capacity.

Re-Mo-Trol Remote Control Puller

Safer to use, operates in tight spots. For pushing or pulling "Center-Hole" arrangements over 30 tons 10-100 tons capacities.

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Simplex Jacks

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A. C. Templeton, 5627 Del Roy Drive, Dallas, Tex.

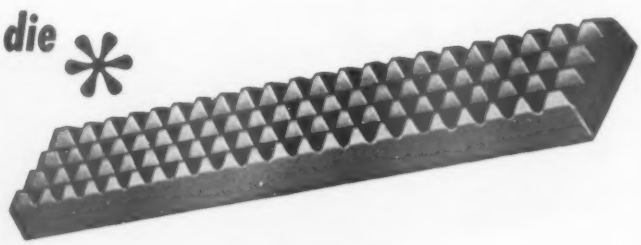
Be on guard

Not all tong dies with pointed teeth are

WEB WILSON THE ORIGINAL PYRAMID TOOTH TONG DIES

Here's the genuine Tiger Tooth die*

Fast-moving crews *know* they grip instantly—won't slip—and last lots longer. ★ Be sure you get the box with the yellow and black "Tiger Stripes"—the *best* dies ever made.



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BE SAFE • BE SMART • BE ECONOMICAL

WEB WILSON Oil Tools Inc. FIELD PROVEN **BOX 96, LOS ANGELES 2, CALIFORNIA**

Be sure the connections
ARE LEAK PROOF!

In LP Gas Underground Storage Tubing Strings

Rectorseal has proved to be the only compound that assures leak-proof joints in LP Gas underground storage tubing strings. Rectorseal is your perfect sealant because it's sure, easy-to-use, economical.

It never hardens—never gets brittle. It's thin in the can but thickens in the joint to a plastic elasticity that assures a positive seal for the life of the connection. Make a test—try the best. There's no seal like Rectorseal. Ask for Rectorseal by name at your Supply Store. If they can't supply you, write

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RECTORSEAL
Manufactured by
RECTOR WELL EQUIPMENT CO., INC.
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MAKING THE OIL INDUSTRY SAFER

Write or Wire
for Monthly Stock Lists

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Peerless Supply Co., Inc.
L. D. 75 & 76 P. O. Drawer 36-A
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Standco
NO-SMOKE
STANDCO BRAKE LINING

Nothing novel — no bunk, but it gets the job done without scoring brake rims. See pages 4811-4830, Composite Catalog.

Standco Brake Lining Co.
HOUSTON

Gulf Coast. The test is carried as 1 Moczygemba. Location is in the A. Hernandez Survey. Nearest production is in the Hobson field, 5½ miles to the west.

Fleet Drilling Co., Ada, Okla., is moving in a heavy-duty rotary rig for a deep outpost test it has under contract to drill for Sohio Petroleum Co. a half mile east of the Eola field, in Garvin County, Oklahoma.

Penrod Drilling Co., Shreveport, has a new contract with Southwest Gas Production Co., Inc., Monroe, La., for a 10,500-ft. wildcat test to be drilled in Orleans Parish, Coastal Louisiana. It is a water-located job on State Lease 2007.

Edwards & Bissett will drill an 8,500-ft. Cook Mountain wildcat test northwest of Juanita, in Beauregard Parish, southwestern Louisiana. J. M. Faitz and associates of Houston are the operators. Location is for 1 Newport, in 13-5s-11w.

Wheless Drilling Co., Shreveport, is drilling on a contract it has with Natural Gas & Oil Corp. and M. A. Halsey for a test on the Jamestown prospect in Bienville Parish, North Louisiana. Location is for 1 Todd, in the C NE NW 32-16n-8w.

Justiss-Mears Drilling Co., Jena, La., has contracted with Dwight Sanford, independent operator, Jackson, Miss., for a 10,000-ft. test to be drilled as an offset to the short-lived discovery well of the Russum field, Jefferson County, Mississippi. The discovery well, drilled by Stanolind Oil & Gas Co., was completed in lower Tuscaloosa sands below 9,700 ft. It produced only 3,025 bbl. of oil before being abandoned. The new operation is 1 Dockery, with location in 17-10n-2e.

ACTIVE ROTARY RIGS*

Area—	Week ended 6-15-53	Change week ended 6-8-53	Change week ended 6-16-52
Gulf Coast	601	+ 5	— 2
N. & W. Tex.-N. M.	809	—11	—165
Ark.-N. La.-E. Tex.	141	+11	— 20
Oklahoma	338	— 2	— 6
Kansas-S. Nebraska	174	+ 4	— 17
Illinois-Eastern	139	— 2	— 24
Rocky Mountains	254	0	+ 25
Pacific Coast	175	+ 5	+ 6
Total U. S.	2,631	+10	—203
Western Canada	191	+ 1	— 7
Total	2,822	+11	—210

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States, and the Pacific Coast and Illinois-Eastern areas are shown on pages 380 and 381.

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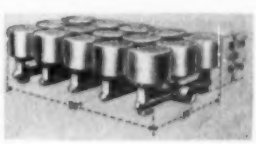

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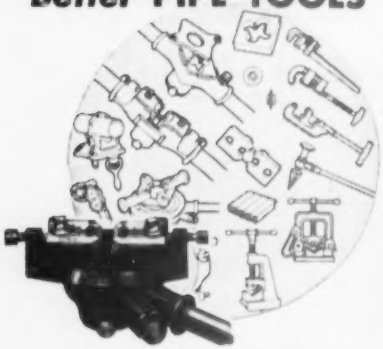

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Exceptionally convenient where space is limited, this stock simplifies pipe threading close to walls, in corners and wherever operating room is restricted. With *adjustable* dies (cut exact, over or under size threads) it is an ideal tool where valves and fittings are being installed or maintained.

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PIPE LINES

Hearings on Northern Gas Construction Set

WASHINGTON.—Further FPC hearings on all remaining matters and issues in Northern Natural Gas Co.'s application for construction of pipeline facilities to transport some 340,000,000 cu. ft. of gas daily to Midwestern customers, have been scheduled for June 23 here.

The construction program is planned to cover a 2-year period. At hearings held May 1 the commission authorized Northern to construct main-line facilities during the first year. Also, it gave Permian Basin Pipe Line Co. and El Paso Natural Gas Co. authority to build lines and other facilities in Texas and New Mexico for delivery of gas to Northern *(The Oil and Gas Journal, May 11, page 163)*. The upcoming hearings are slated to decide issues involving construction during the second year.

During the first year Northern plans to lay about 259 miles of 24 and 30-in. pipe and a total of 50,400 hp. in compressor capacity at a cost of some $33,273,000. This is planned to take place in Texas, Oklahoma, Kansas, Nebraska, and Iowa. In the second year plans call for construction of 204 miles of 24, 26, and 30-in. pipe and 22,800 hp. in compressor capacity at an estimated cost of $22,643,000. However, the authorization of the first year's work is not valid until the remainder of the project is passed upon.

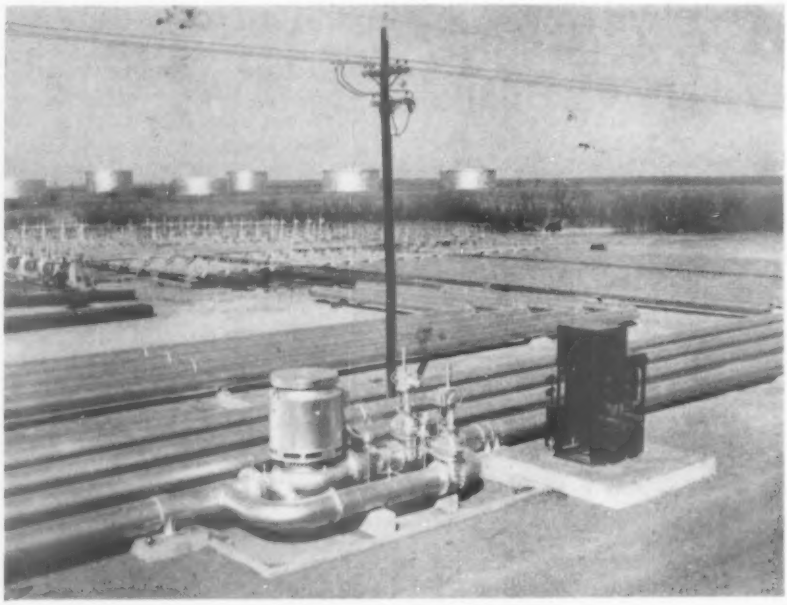
An application to hold a rehearing on its May 1 opinion was rejected recently by the commission. The application was filed by National Coal Association, United Mine Workers of America, Fuels Research Council, Inc., and Chesapeake & Ohio Railroad.

Westcoast's Canadian Line Into Northwest Defended

NEW YORK.—C. H. Gueffroy, president of Portland Gas & Coke Co., has given strong support to Westcoast Transmission Co.'s proposal to import gas from Canada to the Pacific Northwest.

Gueffroy expressed the viewpoint recently before the New York Society of Security Analysts that another proposal to bring gas from New Mexico is too costly. The opposite viewpoint was presented to the group at an earlier meeting by Henry Gellert, president of Seattle Gas Co.

Gellert defended Pacific Northwest Pipe Line Co.'s proposed line from the



In-the-Line Unit Pumps West Texas Crude

This 16-in. in-the-line pump (foreground) boosts crude through piping at West Texas Gulf Pipe Line Co.'s Colorado City, Tex., pump station, western terminus of the huge 466-mile, 26-in. trunk line. At this station, 10 feeder lines, including the 24-in. Mesa pipe line from the Midland area, converge. Station manifold lies between pump and tanks in the background.

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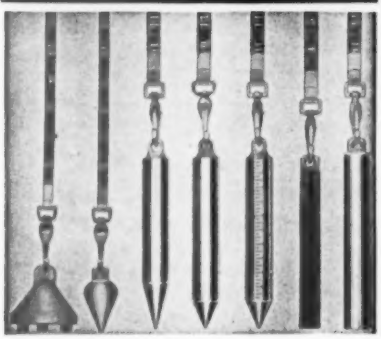

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San Juan basin. He contended the Westcoast line would make this country "an economic vassal" of Canada. However, Gueffroy argued that the United States depends on Canada for nickel, wood pulp, electricity, newsprint, and other materials.

Applications of both companies to build their proposed lines are being studied by the Federal Power Commission.

Laying of North Dakota's First Crude Line Started

TULSA.—Service Pipe Line Co. has started construction on North Dakota's first crude-oil transmission line.

The 154-mile line will transport oil gathered in Tioga and Beaver Lodge fields, in the Williston basin to Mandan, N. D. At Mandan Standard Oil Co. (Ind.) is erecting a 30,000-bbl. per day refinery which will be in operation in 1954.

The line will be 12 in. in diameter for about 60 miles south from Tioga, and will be 16-in. the remainder of the way. Initial capacity of the line will be 30,000 bbl. daily. This figure, with additional pumping facilities, could be increased to 100,000 bbl. per day.

O. R. Burden Construction Corp. Tulsa, is building the line for Service. Work on the line is expected to be completed in mid-November or early December. J. L. Cox & Sons, Raytown, Mo., is seeking permission from the North Dakota Public Service Commission to haul and string pipe for the line.

J. H. Keyes, Jr., area engineer for Service at Casper, Wyo., will be in charge of construction for the company. A. J. Yavorn, Manhattan, Ill., and Loren A. Samp., Riverton, Wyo., will be chief inspectors. They will be assisted by 19 Service employes.

Manufacturers Light Awards Compressor Station Contract

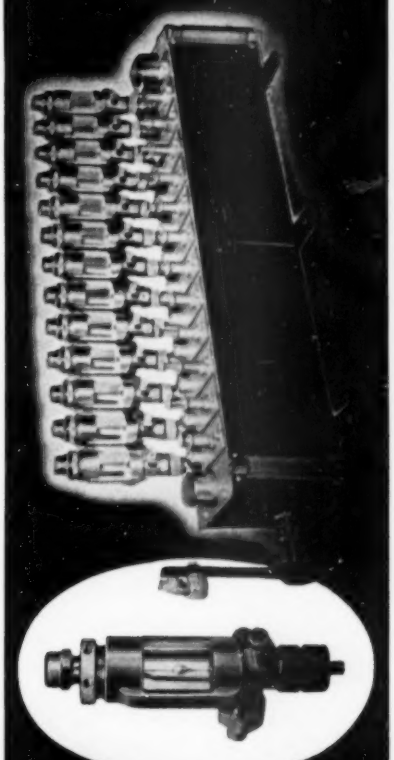
PITTSBURGH.—Dravo Corp. has been awarded a contract by Manufacturers Light & Heat Co. to construct an 880 hp. natural-gas compressor station in West Bradford Township, Chester County, Pennsylvania.

The station will be located at the junction of the twin 8-in. southern pipe lines, 14-in. Port Jervis line, and 20-in. line from Rockville, Md. It will relay gas from Atlantic Seaboard Corp. to Eagle compressor station.

The station will be erected at a low cost since present plans call for it to be used only 3 years. After that time it will either be dismantled or greatly enlarged. During normal operations,

new McCORD Tubular "Clearsite" Feed SF LUBRICATOR

The new McCord "SF" Lubricator delivers a predetermined quantity of oil under pressure at regular intervals to cylinders or bearings. A new improved tubular clearsight feed, a McCord development, shows delivery and quantity of oil. It may be cleaned without removing from pump. Other McCord advantages are easy removal of pump units, welded steel tanks, wide variety of drives, and a new graduated oil level gauge providing greater visibility. McCord offers you an outstanding lubricator, further improved to provide better service. Deliveries are prompt.



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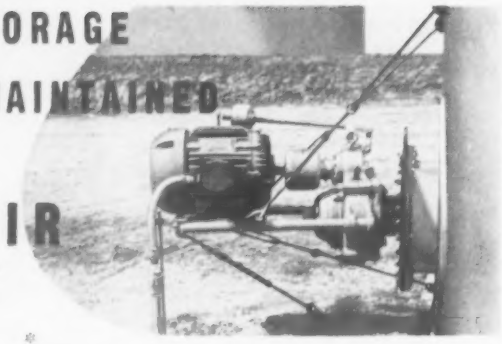

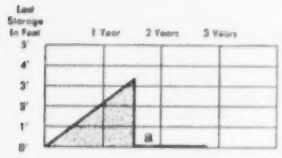

(a) tank cleaned and SHORTSTIR installed.

These records show that sediment had accumulated, in some cases, at a rate of over 2 ft. per year. Tanks were cleaned and SHORTSTIR Mixers installed. Thiefing after one year revealed less than 1" sediment.

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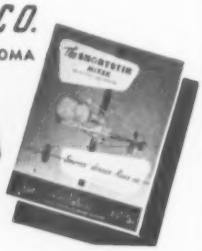

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about 20,000,000 cu. ft. of gas will be pumped daily.

El Paso Testifies on Plans For New Line to California

WASHINGTON.—In testimony before the Federal Power Commission, Paul Kayser, president of El Paso Natural Gas Co., revealed plans for his company to construct a pipe line from the Permian basin to Topock, Ariz.

El Paso is seeking FPC permission to increase its capacity by 400,000,000 cu. ft. daily from the Permian basin and San Juan basin. The program calls for a 30-in. line from the Permian basin north to Gallup, N. M., where it would join a 24-in. loop line to Topock. At Topock it would connect with Pacific Gas & Electric Co. system, which would receive 150,000,000 cu. ft. of gas daily.

He pointed out that the northern route by way of Gallup was selected because it was more economical. Also, he stated the southern route is "stuffed" with lines operating at maximum capacity with compressor stations about 35 miles apart.

He added that the company will be purchasing about 1½ billion cubic feet of residue gas when the project is completed.

N.C.R.A. Products Line Now Entirely Automatic

McPHERSON, Kans.—National Cooperative Refinery Association's 227-mile products line from its McPherson refinery to Council Bluffs, Iowa, has become entirely automatic.

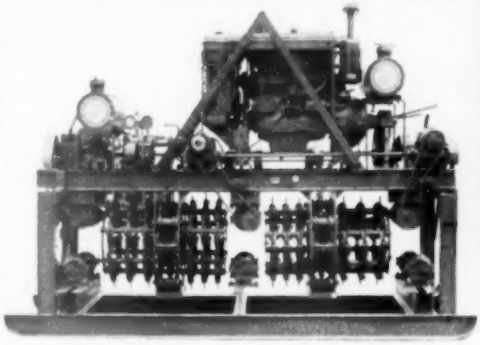
The line is operated by a leased telephone wire system which is controlled at the refinery by one person. Previously, 11 men were needed at three booster stations to operate the 6-in. line.

New Firm Buys Louisiana Crude-Oil-Gathering Lines

LAKE CHARLES, La.—Formation of Lafitte Oil Traders, Inc., has been announced by the two joint owners, Vincent & Welch, Inc. and Cities Service Oil Co. The new company will purchase and operate two oil gathering systems in southern Louisiana formerly owned by Pelican Oil Purchasers, Inc.

The two gathering systems are located in Beauregard, Calcasieu, Allen, Jefferson Davis, and Acadia parishes. One delivers oil directly to Cities Service Refining Corp.'s Lake Charles refinery while the other delivers oil to a terminal 40 miles east of Lake Charles.

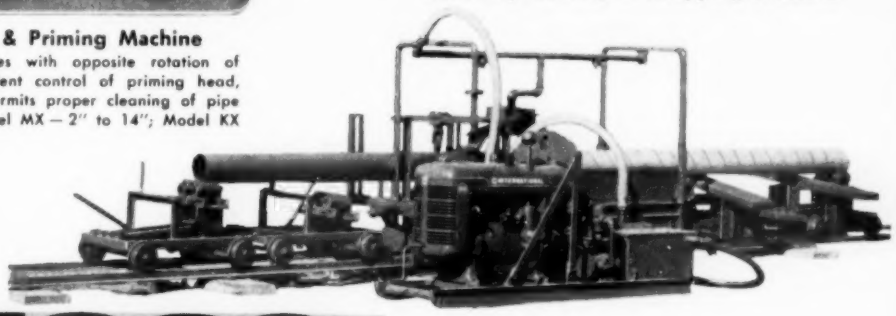
Here's a yard pipe reconditioning setup that will save you money!



Stationary Cleaning & Priming Machine

Has dual head assemblies with opposite rotation of cleaning heads. Independent control of priming head, and pipe input speeds permits proper cleaning of pipe in various conditions. Model MX — 2" to 14"; Model KX — 16" to 26".

Stationary Coating & Wrapping Machine



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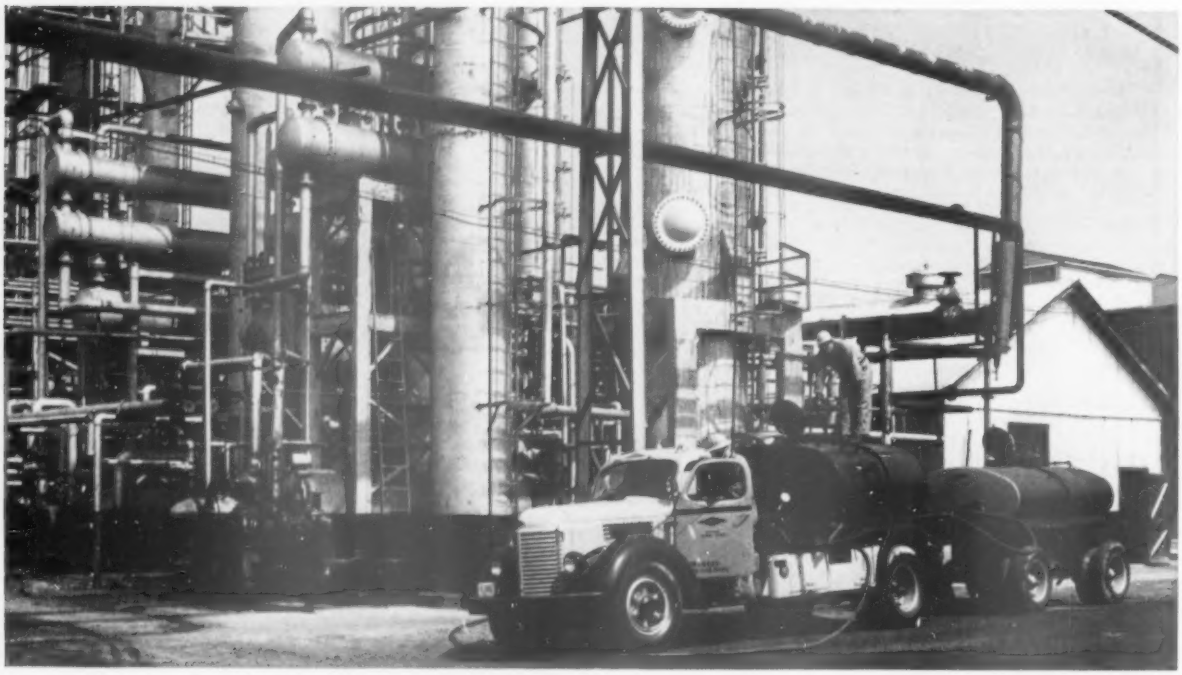

When scale and sludge accumulate on your heat transfer equipment, there's bound to be a reduction in efficiency with an increase in operating costs.

The Dowell method of removing scale and sludge *by chemistry* has been accepted by thousands of plant operators as a fast, safe and economical way to help restore efficiency to equipment.

Dowell was recently called upon to clean three badly fouled heat exchangers in a refinery. Dowell engineers pumped liquid solvents into the areas of the exchangers to be cleaned. Then, after sufficient reaction time, the spent solutions were flushed from the units, along with the sludge accumulations. After cleaning, one unit could carry the load previously carried by all three.

The Dowell method is fast and economical because solvents are pumped into equipment through regular connections without dismantling. Many types of equipment can be cleaned while in operation. No special devices or rig-ups are needed. It's efficient, too, because these solvents reach wherever steam and water flow. Even the most complicated heat transfer surfaces—angles, curves, piping—have been cleaned effectively in this manner.

Furthermore, Dowell furnishes the trained personnel, the truck-mounted tanks, pumps, heaters, mixers and control equipment to do the job.

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REFINING

New Coker Planned

Sunray accepting bids for 9,000-bbl. unit at Duncan

DUNCAN, Okla.—Sunray Oil Corp. plans to begin construction in August of a 9,000-bbl. per day delayed-coking unit at its 25,000-bbl. per day refinery here.

The plant, which is expected to be completed in the fall of 1954, will be operated by Sunray for Ucan Products Co., a newly organized firm in which Sunray has 50 per cent stock ownership. Presently, Sunray is accepting bids for the construction work.

The oil company has received a certificate of necessity from the Internal Revenue Department to amortize 60 per cent of the approximately $4,000,000 investment over a 5-year period. The new plant's output of petroleum coke will be used predominately for defense purposes.

An estimated 360 tons daily of raw petroleum coke from the unit will be marketed through Great Lakes Carbon Co., New York, world's largest purchaser and distributor of these products. In addition the plant will produce fuel gas, propane-propylene, butane-butylene, debutanized gasoline and gas oil for charging stock to cat cracking facilities.

N.P.A. to Give 21 Safety Awards at Convention

WASHINGTON.—Merit certificates for safety achievement will go to 21 refineries when the National Petroleum Association convenes in Toledo, June 25 and 26.

Of the 21 awards 12 will be for "no lost-time accident" records in 1952.

N.P.A. reports the number of awards made each year have been steadily increasing. In 1950 only six awards were presented, and in 1952 there were 18.

During the 2-day meet delegates will tour Sun Oil Co.'s Toledo refinery. This will be followed with a discussion period conducted by Frank Sluze of Ashland Oil & Refining Co.

Cities Service Pushes Work On Lake Charles Expansion

LAKE CHARLES, La.—Cities Service Refining Corp. has started on its second lap of construction here to raise the company's refinery production an additional 25,000 bbl. daily.

Under construction are a new vacuum unit, hydroformer feed-preparation unit, and a fluid hydroforming unit which will include an aviation base fractionation unit. Also, additional tankage, cooling towers, and other general facilities will be included in the $20,000,000 expansion program.

The program began in May 1952, with the construction of additions to topping units, deasphalting unit, catalytic cracking units, power house, and alkylation units. In addition the refinery's acid plant was revamped.

Final work is expected to be completed early in 1954.

Mid-Continent Adding Cat Reformer at Tulsa Refinery

TULSA. — Construction has begun on Mid-Continent Petroleum Corp.'s new catalytic reforming unit at the company's West Tulsa refinery.

M. W. Kellogg Co. is in charge of erecting the unit, which will employ the reforming process developed and licensed by Atlantic Refining Co. The unit is expected to be completed and in operation next spring.

The new unit employing a platinum catalyst, will have a daily charge capacity of 7,500 bbl. of straightrun gasoline and will be capable of producing about 7,200 bbl. of high-octane gasoline.

The new unit will cost Mid-Continent approximately $2,500,000. Since the company completed its catalytic cracking unit in 1949, it has spent between $15,000,000 and $20,000,000 at its West Tulsa refinery on construction of new and expansion of existing equipment.

Federal Oil Taxes Show Slowup to 1952 Level

WASHINGTON. — Treasury collections from the four federal oil taxes have slowed down to approximately the rate of a year ago.

Internal Revenue Bureau records show that gasoline-tax receipts are still above last year but lubricating-oil revenue has dropped substantially, and pipe-line and diesel taxes are just about holding their own.

During the first 4 months of this year the bureau collected $268,960,412 from the gasoline tax, against $247,281,525 in the same 1952 period; $21,881,077 from lubricating oil, against

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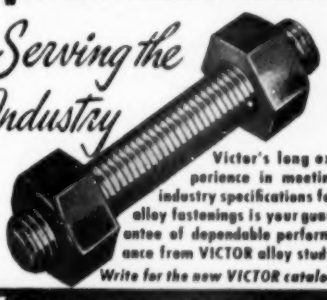

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$36,972,070; $9,142,009 from pipe-line transportation, against $9,313,543, and $4,923,031 from diesel oil against $4,737,493.

For the first 10 months of the Government's fiscal year, revenue from the oil taxes showed an increase of approximately $151,000,000, but less than $6,000,000 of this increase occurred after 1952.

The bureau reported that collections in April included $67,938,555 from gasoline, against $52,075,498 last year; $5,797,570 from lubricating oil, against $15,064,383; $2,744,993 from pipe-line transportation, against $2,208,697; and $1,427,608 from diesel oil, against $1,233,438.

Refining Briefs

NEW YORK.—Lummus has published a study on Shell Oil Co.'s new hydrosulfurization process. Lummus is building the first such unit for Shell at Stanlow, England. Contained in the report are a flow diagram and description of the process; discussion of possible applications; investment and operating costs; utility consumption figures; and economics for two 10,000-bbl.-daily units charging straightrun gas oil and cat-cracked cycle oil, respectively. Free copies of the report may be obtained by writing Lummus Co., Room 359, 385 Madison Avenue, New York 17, N. Y.

CHICAGO.—Standard Oil Co. (Ind.) has announced development of a new summer gasoline which the company reports protects automobile engines against stalling due to vapor lock. Tests were made in the Mojave Desert in California.

WASHINGTON.—Houdry Process Corp. has announced its dehydrogenation process is available. The process is expected by Houdry to boost production of aviation gasoline and synthetic-rubber intermediates from low-cost raw materials.

LOS ANGELES.—Employes of Union Oil Co. of California's refinery here have qualified for safety awards from the American Petroleum Institute and the National Safety Council by having worked more than a million man-hours without a lost-time accident. Employes of the research and process department have worked safely in excess of 1,650,000 man-hours.

DETROIT.—Aurora Gasoline Co.'s refinery here is in the process of going on stream following settlement of a 45-day strike. Union officials report a general wage increase of 7.5 cents an hour was granted.

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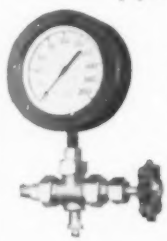

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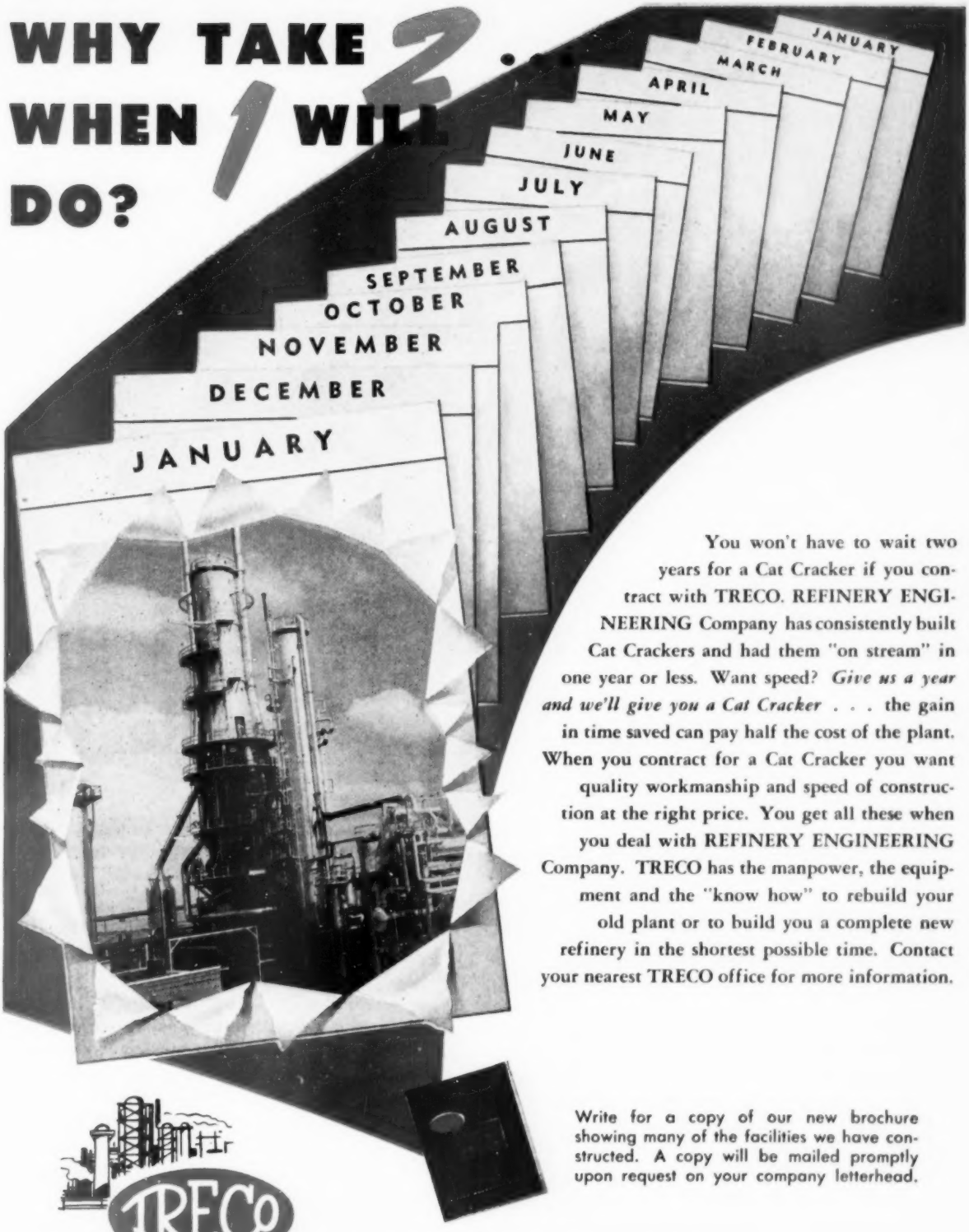

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NATURAL GAS

FPC Hearings Set

Fast decision expected on Panhandle Eastern rates

WASHINGTON.—The Federal Power Commission has ordered intermediate-decision procedure omitted in proceedings involving Panhandle Eastern Pipe Line Co.'s suspended wholesale natural-gas rate increase, amounting to about $21,400,000 annually and has scheduled hearings on suspended rate increases by six other companies involving about $12,279,000 per year.

The order affecting Panhandle Eastern means the case will be decided by the FPC without filing of an intermediate decision by the presiding examiner, who conducted hearings on the proceedings. Panhandle and Michigan Gas Storage Co., an intervener in the proceedings, opposed the action.

The commission noted that the hearings commenced September 5, 1951, and were concluded May 15, 1953. It was pointed out that since the hearings have taken so long and that Panhandle has been collecting the increased rates under bond, subjected to refund, since February 20, 1952, the FPC wants to give the company's customers an early decision.

Other hearings . . . August hearings have been scheduled in Washington concerning suspension proceedings on wholesale natural-gas rates by two Pittsburgh subsidiaries of Columbia Gas System, Inc., Manufacturers Light & Heat Co. and Home Gas Co.

Hearing on Manufacturers' increase, amounting to about $2,200,000 per year, will commence on August 3. Home's increase, totaling about $1,242,000 annually, will come before the commission 2 weeks later.

Both increases have been under suspension since May 1952, and under bond, subject to refund, since November 1.

The commission consolidated for hearing on July 20 two suspension proceedings involving joint filings of two Columbia subsidiaries, Atlantic Seaboard Corp. and Virginia Gas Transmission Corp., of Charleston, W. Va. The hearing will involve a $3,000,000 annual increase by the two companies, which has been under suspension since October 1951, and under bond since March 1952, and a $4,318,000 annual increase suspended last September and under bond since February 15.

Another Columbia subsidiary in Charleston, Amere Gas Utilities Co., will have a hearing August 10 on its proposed $33,000 annual rate hike.

East Tennessee Natural Gas Co., Knoxville, will have a hearing on July 13 concerning its proposed increase of $486,000 annually.

Utilities Add 1,090,000 New Residential Consumers

NEW YORK.—The gas-utility industry added 1,090,000 new house-heating installations during the 1952-53 heating season, despite declines caused in some areas due to restrictions on new heating installations.

The American Gas Association reports the new figure brings the total number of residential heating customers served by the industry to 11,728,000, or 48 per cent of all residential customers. This compares with the 44.7 per cent recorded a year earlier.

Also, the association predicts restrictions will be less severe as pipeline capacities and underground-storage facilities continue expanding. An estimated 1,221,000 new gas house-heating installations are expected to be added during the 1953-54 heating season with 1,200,000 installed in each of the two succeeding seasons.

Damaged Eugene Island Gas Wells Back on Production

CHICAGO.—Pure Oil Co. has resumed full production of five gas wells located 10 miles offshore from Louisiana in Eugene Island field.

The wells were damaged last January when an explosion and fire occurred on the platform as the last well was being completed. The fire was brought under control and all wells capped within 2 weeks. Next, the platform was reconstructed, and necessary marine equipment was installed.

Later a specially designed workover rig was moved in with facilities to place one or more wells on production while the others were being repaired. Deliveries currently are in excess of 70,000,000 cu. ft. daily.

Rhodes Storage Expanded

EL PASO, Tex.—Improvements in facilities at El Paso Natural Gas Co.'s Rhodes underground-storage project have raised daily injections and withdrawals to 50,000,000 cu. ft. and about 80,000,000 cu. ft., respectively.

The company began using the depleted southeastern New Mexico gas field in 1945, storing excess volumes of gas and making withdrawals as needed. With the exception of 1951, injections have exceeded withdrawals for the past 4 years.

Increase in Gas-Company Revenues Reported by FPC

WASHINGTON. — Operating revenues of natural-gas companies reporting to the Federal Power Commission totaled $223,909,775 in March—a 6.4 per cent boost over that of March 1952.

The commission said revenues for the 12-month period ending March 31 were $2,053,043,078, an 18.5 per cent increase over the corresponding period ending in March last year.

Gas sales to ultimate consumers in March were 267,067,000,000 cu. ft., or 5.3 per cent over March 1952.

A decrease of 2.2 per cent was shown in sales to residential consumers and 0.7 per cent to commercial consumers. Sales to industrial consumers jumped 12.5 per cent, however. Revenues from these three classes of service increased 5.6, 7.3, and 23.5 per cent, respectively. Revenues from all sales to ultimate consumers totaled $106,116,917, a 10.8 per cent boost.

The month's net income for the companies of $28,067,848 was a 2 per cent drop from March 1952. The net income for the year ending in March was $214,660,342, a 5.4 per cent increase over the corresponding period ending last year.

A 3.1 per cent boost from March 1952 was shown in gas-utility operating income, which totaled $35,548,461 for the month. For the 12-month period the income was $296,989,733, a 12.5 per cent increase. Net gas utility plant of the reporting companies was $5,054,018,241, a 11.1 per cent increase over last year's figure.

Natural-Gas Sales Up

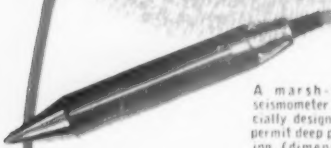
NEW YORK. — Natural-gas sales during the first quarter of 1953 totaled 16,249,000,000 therms, or an increase of 8.7 per cent over the same period last year.

Also, the American Gas Association reports quarterly totals have shown 19,700,000 customers being served with natural gas. A year earlier there were 17,400,000 natural-gas consumers.

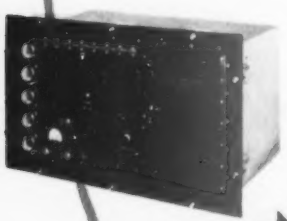
In the second quarter April sales were 4,531,000,000 therms, an increase of 1.3 per cent over sales in April 1952, A. G. A. said.

OUT HERE ...IT'S

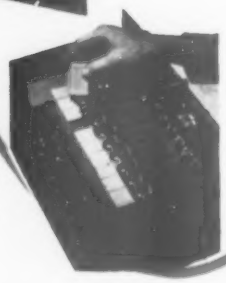
Instruments versus Elements



A marsh-type seismometer specially designed to permit deep planting (dimensions 1½"x10").



General's rugged and weather-proof oscillograph with complete plug-in type components.



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EXPLORATION

Salt Domes Still Reign in Gulf Coast

by Philip C. Ingalls

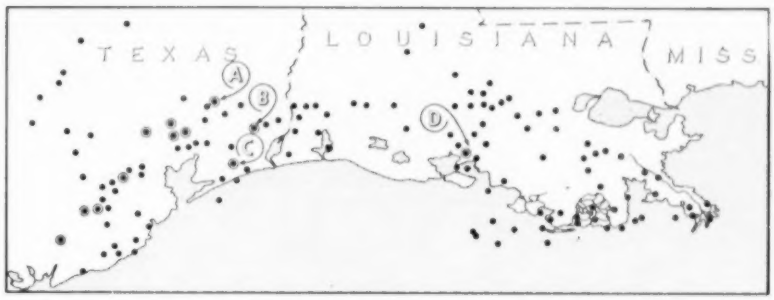
ALTHOUGH the Gulf Coast is no longer just the salt-dome province that it was for the first quarter of a century of oil development in that region, salt domes continue to play a most important role throughout much of the area.

There seems to be no limit to the oil-producing potentialities of a salt dome. Despite steady drilling ever since salt domes were recognized, a sizable portion of Gulf Coast drilling activity is still devoted to the environs of salt domes. The longevity of active salt-dome exploration is well illustrated by the fact that today there are more than 100 active locations at salt domes discovered and explored before the introduction of dome-finding geophysics about 30 years ago. More recently found domes are getting an even greater play.

A check of drilling reports of the Upper Gulf Coast of Texas and South Louisiana shows 12 of the long-known domes with 4 or more active locations (circled on sketch map). Of these 12 salt-dome fields, 4 are of especial interest.

At B on map is Spindletop, the first discovery on the Gulf Coast. This 1901 discovery has five active locations and new reserves have been opened at this famous field within the past year. At C on map is Big Hill field. This dome, known before 1901, produced a little oil in the mid-1920's but it wasn't until 1949 that a real oil field was developed on its flanks. Currently there are seven drilling locations aimed to develop reserves that have been indicated in flanking sands. At A on map is Saratoga, another dome known prior to 1901, which currently has seven active locations.

On to the east in Louisiana many of the known salt domes are deeply seated and most of them were found by seismic surveying. Exceptions are five in-line piercement domes which have developed prominent islands in the coastal marshes. The "Five Islands" were known to be salt domes before the turn of the century. Weeks Island (D on map), one of the Five Islands, did not produce oil until 1945 but is now Louisiana's largest producing field. Here also is the deepest production in the United States, 17,083-17,122 ft. Five rigs are currently active at this dome.



Map of original Gulf Coast area showing salt domes.

How is it that salt domes with their comparatively small surface area go on and on yielding additional reserves?

If the movement of the salt plug into its present position had resulted in a simple bowing up of strata, activity certainly would not have been long lived—structures would have been drilled up at least as fast and thoroughly as the anticlinal fields of Oklahoma. The intrusion of salt did not result in mere bowing up, however. These fluid salt plugs cracked, squeezed, shattered, and overthrust younger strata in every conceivable manner and then some. As a result, once exploratory drilling had graduated from the cap rock to the flanks of salt domes, it ran into structural complexities unimagined in any other oil country. Salt domes seem to offer an endless number of segments and deeper sands containing oil pools independent of those often but a few feet away.

There are still many salt domes on the Gulf Coast which have produced little or no oil. It is generally agreed, however, that sufficient exploratory drilling at any one of them will find oil. Gulf Coast operators have a great respect for all salt domes, productive or nonproductive.

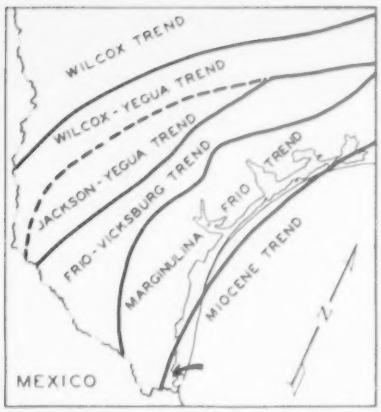
HIGHLIGHTS OF WEEK'S DEVELOPMENTS

SASKATCHEWAN . . . A production of 400 bbl. of 27°-gravity oil per day was indicated in the most recent production test made at Shell Oil Co. A-7-18 near Midale in the Saskatchewan portion of the Williston basin. Production at the new Williston strike is from the Charles (Mississippian).

DENVER BASIN . . . Sherrod & Apperson recovered 500 ft. of clean oil and 400 ft. of heavily oil-cut mud on drill-stem test in the Greenhorn at their second discovery in this formation in northeastern Colorado. Completion of the well, located in Empire field, would confirm Greenhorn production in the basin.

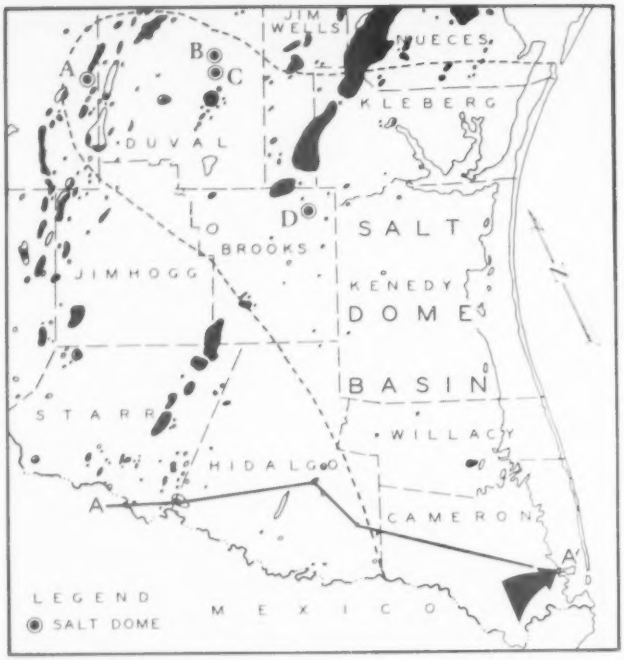
WEST TEXAS . . . Gulf Oil Corp. 1 Lea, Crane County discovery, found the water level in testing to 8,448 ft. This gives the well nearly 300 ft. of indicated pay section in the Ellenburger, plus Simpson sand section which flowed oil on drill-stem tests at 7,530-60 and 8,032-82 ft.

SOUTHEAST NEW MEXICO . . . Stanolind Oil & Gas Co. 1-AB State, deep wildcat in the shallow Empire pool, tested gas at 9,980-10,154 ft., and gas with distillate from 10,135-10,241 ft. Tentative identification of the section was either basal Wolfcamp or Permo-Pennsylvanian.



MIOCENE TREND is a new objective for exploration in the Rio Grande embayment. Arrow points to Texas Gulf Producing Co. 1 J. A. Garcia, recent Miocene gas discovery at 7,315-25 ft. 8 miles west of Point Isabel, Cameron County, Texas. (Fig. 1).

by Joseph A. Kornfeld
District Editor



SALT-DOME BASIN of Rio Grande embayment includes these piercement-type domes: Moca (A), Palangana (B), Piedras Pintas (C), and Gyp Hill (D). Moca produces Eocene oil, Palangana and Piedras Pintas from cap rock, while Gyp Hill is barren. A-A is line of section for Fig. 3. (Fig. 2).

Miocene Gas Strike Spurs Rio Grande Embayment Work

RECENT discovery of gas in Miocene strata at a Cameron County, Texas, wildcat spurs interest in exploration for gas-distillate reserves in the Rio Grande embayment.

Fig. 1 portrays the Miocene belt which is the most easterly of a series of five regional exploration trends in South Texas. Lying successively to the west are the Marginulina-Frio, Frio-Vicksburg, Jackson - Yegua, Wilcox-Yegua, and Wilcox trends. Exploratory work has been active in all of these trends for a number of years. The new Miocene gas discovery, however, focuses interest on eastern Willacy and eastern Cameron counties where Miocene reserves lie at depths ranging from 7,000-9,000 ft., several thousand feet shallower than Oligocene-Frio sands which have been developed in the coastal tier of counties.

The Miocene gas discovery is 8 miles west of Point Isabel at Texas Gulf Producing Co. 1 J. A. Garcia (arrowed on Figs. 1 and 2), in the Portrero de Santa Isabel Grant. It is shut in after gaging 2,670 M.c.f. of gas per day with trace of distillate flowing through a ¼-in. choke with a tubing pressure of 1,800 psig. Production is from casing perforations at 7,315-25 ft.

Additional exploration in the Miocene belt is the rank wildcat test of Union Oil Co. of California 2 Mellie Esperson started 15 miles northeast of Brownsville. This test lies 8,000 ft. west of Union 1 Mellie Esperson, a 12,956-ft. dry hole drilled last year in Block 8. Projected for 11,000 ft., the new test lies about 15,250 ft. north of the Rio Grande and is the southernmost drilling operation in the United States except for those drilling in the South Florida basin.

Marginulina-Frio Trend

Meanwhile, in the coastal tier of counties, development work continues near a series of gas-distillate and oil discoveries completed from the Marginulina-Frio in or near the Laguna Madre during the past 1½ years.

Callandria field . . . In the southeastern corner of Kenedy County, Callandria field was discovered on February 5, 1952, by Humble Oil & Refining Co. The area, situated 22 miles northeast of Raymondville, was opened by its 2 King Ranch-San Jose Farral in the San Juan de Carricitas Grant; it was completed from Frio sand perforations at 8,675-90 ft. for an absolute open-flow of 23.2 M.M.c.f. of gas per day. Distillate gravity was 45° A.P.I.

Gas-well discovery of Potrero Lopena field in Kenedy County was completed on July 7, 1952, by Pure Oil Co. Located 27 miles southeast of Sarita in the Laguna Madre waters, its 1 State Tract 285 was completed from lower Frio perforations at 9,463½-70½ ft. Initial flowing potential was 9.4 M.M.c.f. of gas per day. Total depth was 9,491 ft. in sidetracked hole; original hole was drilled to 11,850 ft.

Oil-well discovery at Potrero Lopena field was completed about 4 months after the gas discovery by the same firm. Pure's 1 State of Texas, Laguna Madre Tract 284, 5,550 ft. northeast of the gas well, was finaled from Frio perforations at 7,486-7,501 ft. It flowed an initial potential of 182 bbl. of 38.4°-gravity oil plus 146 M.c.f. of gas per day on a 15/64-in. choke.

Development of these gas-distillate reserves (Miocene and Marginulina-Frio) are of great interest to operators of big-inch natural-gas pipe lines originating in the Rio Grande embayment who are faced with the problem of finding more and more reserves for in-

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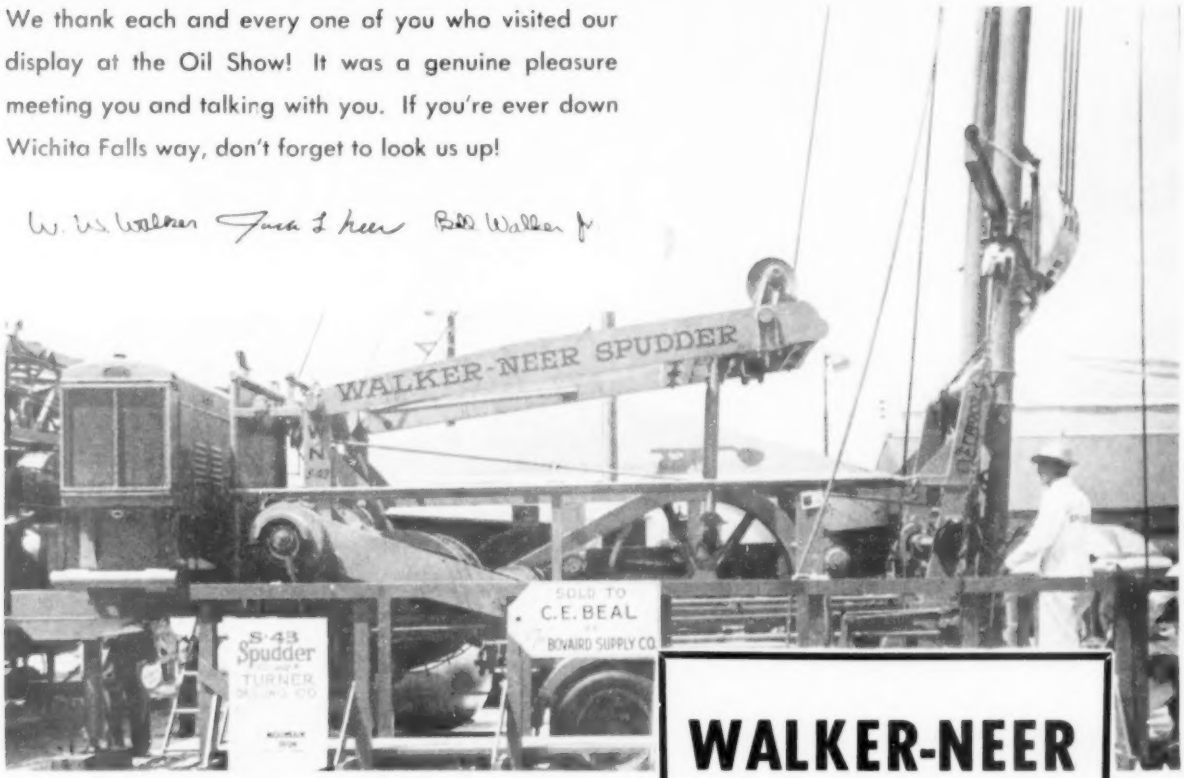

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To those who missed the Oil Show, or who desire further particulars, we would be pleased to send descriptive literature.

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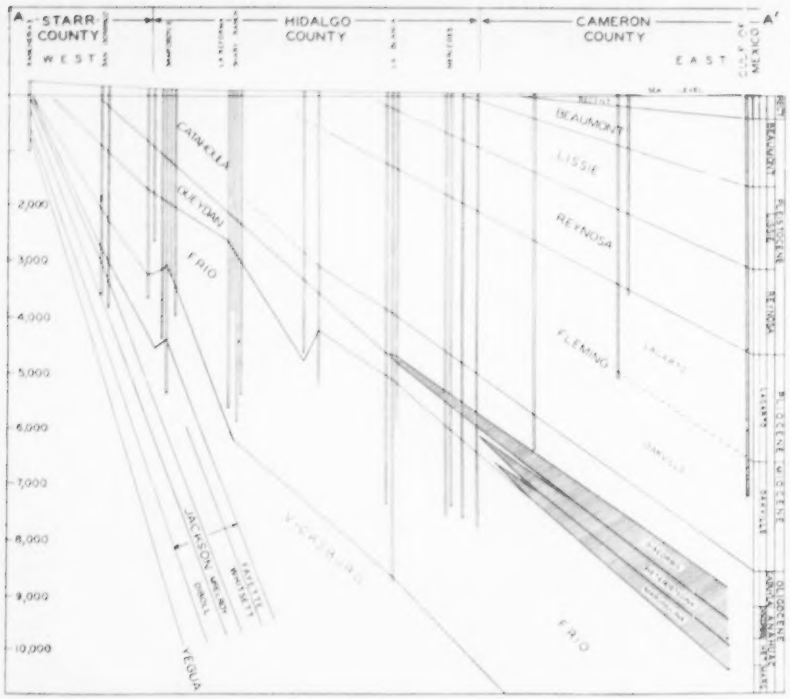

GEOLOGIC CROSS-SECTION of Rio Grande embayment along a west-east line of section extending from Rancherias, Mexico, opposite Starr County, Texas, eastward for a distance of 125 miles to Point Isabel, Cameron County. At Point Isabel, post-Oligocene strata exceed 8,000 ft. See Fig. 2 for line of section. (Fig. 3).

creased deliverability needs to meet expanding markets.

Considerable acreage is under lease in Laguna Madre lying on both trends described above. These tracts will continue to be developed through the use of submersible drilling barges. Currently, Brewster & Bartle and Southwestern Drilling Co. are operating drilling barges in Laguna Madre waters of Kenedy County; these are working on 7,500-ft. contracts.

Salt-Dome Basin

Current work in these trends occurs in a salt-dome basin shown in Fig. 2 Four piercement-type domes are known from updip areas on the northwest side of the Rio Grande embayment: Moca (A) in Webb County, Palangana (B), and Piedras Pintas (C) in Duval County, and at Gyp Hill (D) in Brooks County. Initials refer to map location. Subsea depths to the top of salt plug on each of these domes are 5,150 ft., 500 ft., 650 ft., and 1,400 ft., respectively. Anhydrite and limestone cap rocks of these domes attain thicknesses of 400 ft. at Palangana, 500 ft. at Piedras Pintas, and 800 ft. at Gyp Hill. Cap-rock oil is produced from both Palangana and Piedras; Gyp Hill is barren of oil or gas; and Moca produces oil from Jackson sand leases.

Downdip from these piercement-type domes are a number of major structures resulting from deep-seated salt domes. Downdip pinchouts characterize important Frio fields such as Tobasco in Hidalgo County.

Stratigraphy

Upper Jurassic . . . Up to 1,500 ft. of Upper Jurassic rocks are estimated to be present in the western half of the Rio Grande embayment. These Kimmeridgian and Portlandian beds thicken gulfward from the Nuevo Leon-Tamaulipas peninsula of northeastern Mexico.

Cretaceous formations . . . Rio Grande embayment lies along the eastern rim of the Cretaceous geosyncline extending north and westward from Central America throughout Mexico, West-Central United States, and Canada. Lower and Middle Cretaceous rocks in the Rio Grande embayment are of marine character; a maximum of 1,000 ft. is represented. Lithology is mainly dense limestones interbedded with marl and shale. These rocks thicken westward into a Cretaceous basin lying in central northern Mexico where they attain a maximum thickness of 8,000 ft.

Upper Cretaceous sea covered all of the Rio Grande embayment. These sediments thicken eastward from 1,000 ft. to more than 5,000 ft. at the coastline. Lithology is a regressive series of thin-bedded limestones, marls, and shales, with thin silty and sandy layers.

Eocene . . . Eocene sediments (Midway, Wilcox, Claiborne, and Jackson stages) increase from the outcrop belt in the Rio Grande embayment eastward; these rocks have a thickness of more than 20,000 ft. at the coast line. Wilcox, Claiborne, and Jackson rocks produce oil and gas at the western rim of the Rio Grande embayment.

Oligocene . . . Rocks of Oligocene age represented include equivalents of the Vicksburg, Frio, and Anahauc formations (see Fig. 2). At the coast line, Oligocene rocks attain a thickness in excess of 25,000 ft. At the outcrop to the southwest in northeastern Mexico, the Oligocene rocks are near-shore clastics; these grade eastward into marine shales, thickening gulfward. Vicksburg and Frio formations contain important reservoirs of natural gas and distillate throughout Hidalgo, Starr, and Willacy counties.

Post-Oligocene . . . Miocene, Pliocene, Pleistocene, and Recent sediments comprise the post-Oligocene rocks present in the Rio Grande embayment. At Brownsville, north of the Rio Grande, these have a combined thickness in excess of 8,000 ft. Miocene rocks produce gas distillate in Cameron County and over the Kingsville dome in Kleberg County. Pliocene-Miocene strata produce oil over a few deep-seated domes in Brooks County.

KANSAS

Seven New Discoveries Completed in Kansas

Operators continue the steady pace of new discoveries in Kansas as seven new strikes were completed in six counties.

Central Kansas uplift . . . Five new pools were opened on the Central Kansas uplift, one of them in the sparsely productive extreme northern end of the uplift. Jones, Shelburne & Farmer opened Columbia pool in the center of Norton County at 1 Lawson, SE SE NW 36-3s-24w. The discovery was completed for 200 bbl. of oil per day from the Arbuckle.

Barton County has two new pools, Ess and Pendergast. Petroleum, Inc., opened Ess pool at 1 Essmiller "C," NW SW SW 13-19s-14w, with a pump potential of 208 bbl. of oil per day from the Lansing. Pendergast pool is a new Lansing producer, opened at Schermerhorn Oil Corp. 1 Pendergast, SW SW NE 27-19s-15w. The well was finished for 106 bbl. of oil daily.

Rooks County on the northeastern side of the uplift has a new pool at W. L. Hartman 1 Adams "A," NE NE NW 31-9s-17w. The Lansing discovery was finaled for 214 bbl. of oil daily on the pump.

Natural Gas & Oil, formerly Westgate-Greenland Oil Co., opened Dunes Southwest pool at 1 Koelsch, SE NE NW 33-22s-15w, with a pump potential of 141 bbl. of oil per day from the Lansing in Pawnee County on the southwestern side of the uplift.

Salina basin . . . At the extreme southern end of the Salina basin John J. Darrah completed 1 Boese, SE NW NW 34-19s-2w, with a pump potential of 108 bbl. of oil per day from the Mississippi.

Southern Kansas . . . Cowley County's new pool was opened by Laura Jane Oil Co. at 1 Hoornback, SE SE NW 5-33s-4w, with a pump potential of 240 bbl. of oil per day from the Bartlesville sand.

New Pool Reported in Southern Salina Basin

Successful production tests are being taken at a new discovery in the extrem southern extremity of the Salina basin of Kansas in McPherson County bringing to five the total of new strikes in this area this year.

Anschutz Drilling Co. 1 Fleming, SE SE NE 10-20s-4w, about 5 miles southwest of

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McPherson, is the new pool opener, establishing first production in this township. The well made 10 bbl. of oil per hour for 9 hours on the pump from the perforated Simpson zone at 3,728-36 ft.

New Tests Reported for Norton and Sheridan Areas

Three new wildcats are scheduled for the sparsely productive northern extreme of the Central Kansas uplift in Norton and Sheridan counties. Empire Drilling Co. is moving in rotary tools at a wildcat 1 mile west and ½ mile north of Columbia pool in the center of Norton in SE SE SW 26-3s-24w. Two new wildcats are slated for Sheridan County. Graham-Messman-Rinehart Oil Co. has a wildcat in the SE NE SE 35-7s-26w, 3½ miles north of Studley pool and one in the NW NW NE 4-7s-29w, 2 miles southwest of Wessell pool.

OKLAHOMA

Layton Show Reported in Northeast Prairie Valley

Mercury Drilling Co. and P. G. Lake are drilling ahead after encountering a show in the Layton sand at 3 Cogswell heirs, pool well in the northwest section of New Northeast Prairie Valley pool in Garfield County.

The well had a recovery of 32 ft. of oil and gas-cut mud on a drill-stem test at 4,352-60 ft. in the first Layton (Pennsylvanian) sand. The 3 Cogswell heirs is located in the SW NE NW 5-23n-4w.

The field's productive zones at present are the Marshall, Misener, Mississippi and second Wilcox. The pool was opened earlier this year at F. A. Gillespie & Sons and Fordee Rhoades in the second Wilcox sand and Mississippi gas-distillate pay at 1 Cogswell heirs, SW SE NW 5. George Deck et al recently opened Marshall sand production in the pool at 1 Dyer, SW NW SE 5-23n-4w. Their discvoery well flowed 35 to 40 bbl. of oil per hour. Mercury Drilling Co. completed a Misener and Mississippian well in the west offset spot to the discovery well of the field, 1 Cogswell heirs.

Arrow points to Union Oil Co. of California 1 Hoffman, Woods County wildcat in the C SW NW 30-29n-19w. This far northwestern Oklahoma wildcat is drilling ahead in Mississippi lime after making a drill-stem test of possible Pennsylvanian-Marmaton pay. Recovery on the test at 5,434-39 ft. was 2,000 ft. of gas, 120 ft. of heavily oil and gas-cut mud and 1,200 ft. of gas-cut salt water. The wildcat is located in a rank exploratory area 3 miles south of the Kansas line. At A on map is the indicated Mississippian-Chester gas discovery of I. W. Siegel in Clark County, about 5 miles southeast of Theis pool.

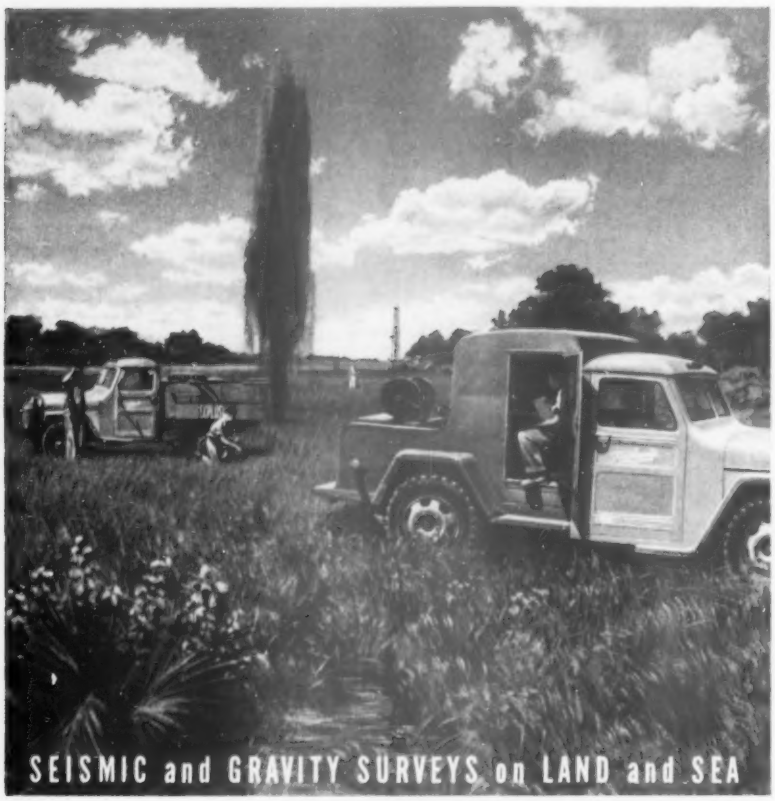
New Pay at Southwest Navina in Logan

New Southwest Navina pool in Logan County, north central Oklahoma, has an indicated new pay discovery and confirmation well. Macmillan Petroleum Corp. 1 Berg, SW SW NW 14-15n-4w, flowed an average of 10 bbl. of oil per hour from the Simpson dolomite perforations at 6,475-90 ft. after acid treatment. Flow was through a 24/64-in. choke. Operator perforated the upper Simpson zone at 6,430-65 ft. and is swabbing tubing on a natural test.

The pool was opened in March and Macmillan 1 Krout in the NE NW SW 14-15n-4w. Initial production of the discovery well was 315 bbl. of oil per day, flowing, from the second Wilcox sand at 6,478-88 ft. and 6,501-39 ft. Description of the field is as follows: 15n-4w: Sec. 14-NW¼ SW¼.

Logan-Noble County Activity

First pump gages are being taken at the first successful confirmation try in Southeast Evansville pool in Logan County. Walter Duncan 1 Cora Adams, NE NW NW 30-15n-1e, recovered 42 bbl. of oil per day with a show of water. Duncan 1 Jackson, NE NE SE 35-15n-4w, discovery east of Lockridge, flowed 78 bbl. of oil per day from the Prue sand.



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Wilcox Oil Co. is moving in at 1 Swart in C SE NW 17-20n-1e, Noble County wildcat north of Logan County. The well is a north offset to the discovery well, Wilcox 1 Carl in NE NE SW Section 17, which was completed on the pump for 95 bbl. of oil per day from the lower Cleveland sand. Casing has been set at a possible strike northwest of Polio pool in NE NE NW 7-22n-2w. A shallow test recovered 400 ft. of oil at Goe Drilling Co. and G. M. Henry's wildcat.

* * *

More Work for Lincoln

Lincoln County continues to report more exploratory work. Deep Rock Oil Corp. plans a wildcat at 1 Tom Rowan "A," SE SE SE 9-15n-4e. The test will go to 4,590 ft. The new try is located 3 miles east of Mt. Vernon pool's southern end. Ben J. Taylor will soon begin at 4,200 ft. wildcat 2 miles northeast of Stroud at 1 Anglin in SE SE NW 14-15n-6e.

CALIFORNIA

Another Shallow Pay Given Wheeler Ridge

Richfield Oil Corp. has added another pay zone, the Olcese sand of Middle Miocene, to the Eocene producing area southwest of the old Wheeler Ridge field in San Joaquin Valley. The company's 34-28 Gordon, on the edge of old production and furthest northeast stepout yet drilled by Richfield in the new development, flowed at the daily rate of 1,374 bbl. on a formation test at 3,875-3,960 ft.

The operator announced the sand had tested productive in two other wells but that the 34 Gordon showing was the best yet. As in the case of the two previous tests, as well as other pays found above the 10,000-ft. Eocene, the horizon is being cased off at this time. At the first of last week 34 Gordon was drilling below 4,304 ft.

At its 54-29 K.C.L.-D, ¾ mile west, salt water was recovered when the Eocene section at 10,306-31 ft. was tested. The well, a northwest edge test, had been drilled to 10,395 ft. where 7-in. casing was set. Richfield was preparing to test the interval at 9,966-10,020 ft. following the unsuccessful attempt.

Yolo Gas Field Extended

An Ohio Oil Co. wildcat in the Winters area of Yolo County, and about 1¼ miles northeast of Pleasant Creek gas field, indicated it would make a good gas producer. On a formation test at 3,575-3,611 ft. it flowed at the rate of 7,000 M.c.f. daily on a 20-minute test. The wildcat, 1 A. H. Rominger, is located in NW SW 4-8-1w.

Outpost for Lost Hills Find

Tide Water Associated Oil Co. has staked location for a 1¼ miles northeast step-out to its recent lower Pliocene sand discovery in the Farnsworth area of Lost Hills field, Kern County. The new test will be 63-8 S.F. & F. L. in SW NE 8-25s-20e. Its 14-17 Farnsworth was completed early in April as a 35-bbl. per day pumping well, producing from the Williamson sand at 2,728-68 ft.

Deep Tests Drilling Ahead

California's deepest test to date, Ohio Oil Co. 72-4 K.C.L.-A, in the Paloma field southwest of Bakersfield, was continuing to push

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the record still deeper. At the first of last week it was drilling at about 19,200 ft., almost 500 ft. below the state's previous deepest well, Superior Oil Co. 1 Limoneira in Ventura County.

Another San Joaquin Valley test scheduled to go below 20,000 ft. was that of Richfield Oil Corp. in nearby North Coles Levee. This well, 67-29 K.C.L.-A was drilling below 13,750 ft.

New Ventura Depth Record

Having already established a new drilling depth record for the Ventura Avenue field, Shell Oil Co. was attempting to complete 378 Taylor at 15,436 ft., only about 100 ft. short of the state producing depth record. The deep test is believed to be bottomed in the field's new D-8 zone, in which Shell, Tide Water Associated Oil Co. and General Petroleum Corp. already have registered completions.

On the extreme eastern end of the field, in 20-3n-22w, Lloyd Corp., Ltd. 3 W. Sexton was drilling at 15,060 ft. Running lower stratigraphically than 378 Taylor, the Lloyd test probably will set a new field depth record.

MICHIGAN

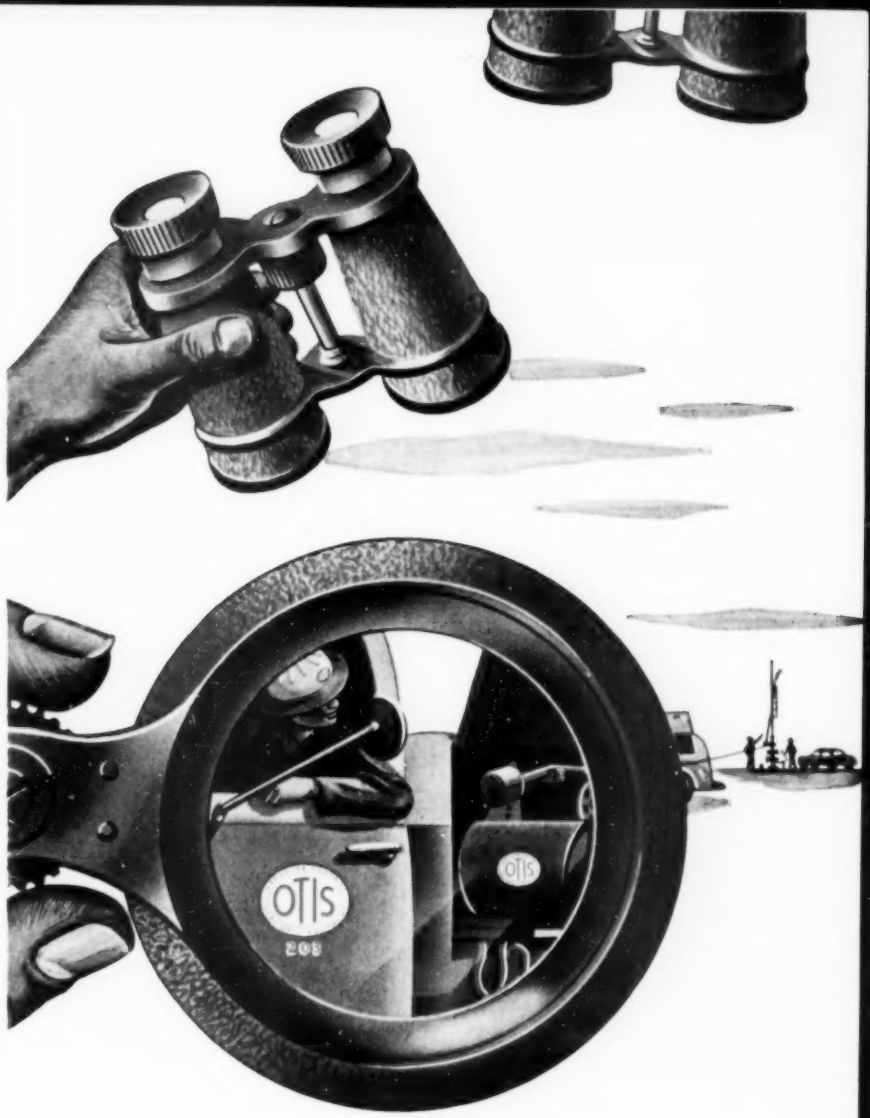
Mecosta Wildcat Is Dry Gas Discovery

Perforations of the Michigan Stray sand resulted in successful completion as a dry gas well at the C. W. Collin & Granville C. Berlin 1 Mecosta Lakes Co. et al, SW SW SE 17-14n-8w, Morton Township, Mecosta County.

Well showed for 4,770,000 cu. ft. of gas a day after the Stray gas pay was perforated. This wildcat was drilled out dry in both the Traverse and Dundee oil objectives and was plugged back to 1,543 ft. from 3,690 ft., total depth. Best pay opened by the perforating appeared to be from 1,314-26 ft. Well is located about 2 miles east of the Michigan Consolidated Gas Co. Austin field gas storage reservoir, Mecosta County, and is about 1½ miles west of other Stray sand gas producers in Morton Township. Well may be a new discovery, but it is believed likely that it could be an extension of the gas reservoir area. Two new locations were tentatively announced for the area of the new well this week by Rex Oil & Gas Co. et al but drilling had not been started at either new location: In the C NE 20 and the C NW 20-14n-8w.

Sun Oil Co. was restricting oil flow to 160 bbl. a day from its 1 Coskey et al, NW NW SW 36-20n-4w, Frost Township, Clare County, a major northwest extension of North Hamilton Richfield oil pool. The Sun well was being flowed at a restricted rate and for only about 6 hours daily after acid treatment with 6,000 gal. in the Richfield to 23 ft. of effective pay logged at various points from 5,220-5,327 ft. Well is the first producer in Front Township, one of the best completions in the pool and is about 1½ miles northwest of the nearest oil producer in the pool. Sun had started drilling operations at the 2 Gronda et al, NW NE SW 36-20n-4w, the east 40-acre offset to the extension producer.

The W. B. Darke 1 Webster, SE NW SW 22-10n-6w, Evergreen Township wildcat, Montcalm County, was being pump-tested in the Traverse after acid treatment with 500 gal., and with excessive water showing. Well, which is under test at 2,812 ft., total depth, showed for 30 bbl. of oil and 189 bbl. of oil first 40 hours of pumping.



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CANADA

Devonian Discovery is Reported at Morinville

Quinalta Petroleums, Ltd., of Calgary has discovered 36.6°-gravity crude oil in the D1 zone of Devonian at its exploratory driller in the Morinville area of central Alberta.

Crude oil was recovered during several drill-stem tests at the well, however, formation water was also present at all of tests, indicating that the well has prospects for only a few feet of water-free oil zone.

The discovery came at Quinalta 1-7-24 Morinville, LSD 7, 24-55-25w4, the first well in the general region to test the D1 horizon. Site is 1 mile south of the Ajax 15 Morinville Cretaceous gas well and 1¼ miles northeast of No. 20 gasser. Crew entered D1 at 3,807 ft., or 1,509 ft. below sea level.

Initial test in the D1 was run from 3,806-36 ft. for 1 hour. Recovery consisted of 630 ft. gassy oil, 450 ft. gassy oil-cut mud, 270 ft. salt water and 630 ft. gassy mud. Crew backed up in the hole and tested from 3,806-20 ft. with 1 hour recovery being 1,440 ft. oil and 270 ft. salt water. Test from 3,806-16 ft. gave up 1,450 ft. clean gassy oil and 250 ft. salt water; while test from 3,845-65 yielded 100 ft. gas-cut mud and 80 ft. gas-cut salt water in 1 hour. The well, scheduled as a D3 Devonian test, is now deepening below 3,865 ft.

South Westerose . . . The California Standard Co. has discovered 'wet gas' in the D3 Devonian coral reef at its South Westerose area wildcat, in the Wizard Lake-Bonnie Glen-Pigeon Lake reef trend, 25 miles southwest of Leduc oil field.

The discovery came at Cal Standard 15-11 South Westerose, LSD 15, 11-45-1w5, 4¼ miles southwest of D3 oil wells at Westerose and 10 miles northeast of the Homeglan D3 discovery. D3 reef was entered at 7,548 ft., or 2,921 ft. below sea level, and first test was run from 7,535-51 ft. Natural gas flow rate was 3,120,000 cu. ft. daily—no fluid recovery. Drill-stem test from 7,553-61 ft. flowed gas at rate 4,187,000 cu. ft. per day and yielded pipe recovery of 70 ft. condensate and 15 ft. drilling mud. Crew is setting string of protective casing preliminary to proceeding in search of an oil column.

Hamilton Lake . . . A ¾ mile oil extension has been chalked up in the Viking sand at a step-out venture in the northern sector of Hamilton Lake, 135 miles northeast of Calgary and 40 miles northeast of Hanna.

The new oil well is Dragon-Ranchmen's 6-31 Hamilton Lake, LSD 6, 31-35-9w4, 3¼ miles north-northeast of the Marwayne-Ranchmen's 6-17 Viking oil well and 2 miles east of British Empire's 6-33 abandoned gas well. A 2-hour drill-stem test in the Hamilton Lake sector of the Viking formation, from 2,980-3,005 ft., flowed natural gas to the surface in 10 minutes at rate too small to measure and gave pipe recovery of 1,320 ft. of clean oil and 30 ft. oily mud. An indicated 15 ft. (combined) oil pay thickness is indicated, including the oil zone present in two sands above the Hamilton Lake zone.

Many Island Lake . . . Britalta Petroleums, Ltd., and Deep Rock Oil Corp. have obtained natural gas success at a step-out venture in the Many Island Lake area of southeast Alberta, 15 miles northeast of Medicine Hat. This delineation test, in the northern sector of the indicated commercial gas producing area at Many Island, found 25 ft. of gas zone in the Medicine Hat sand.

The new gas well is Britalta-Deep Rock 14 Many Island, LSD 10, 33-14-3w4, 5 miles west of No. 4 and 6 miles north of No. 12,

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both capped gas wells. Crew entered the gas sand at 1,500 ft. Gas flow rate is around 1,000,000 cu. ft. daily.

Saskatchewan-Williston area . . . Shell Oil Co.'s Mississippian discovery at Midale, the A-7-18 Midale, has been completed for 400 bbl. of 27°-gravity oil per day from perforations at 4,596-4,636 ft. in the Charles-Mississippian.

Initial potential was based on a 3¾-hour test through a ½-in. choke. The well had been treated with 18,500 gal. of acid.

Shell Oil Co. is drilling an offset well to the northeast of the discovery on a 40-acre spacing. The well, Shell A-9-18, is presently drilling at a depth of 3,648 ft. Another well, Shell 3 Estevan, is being drilled 6 miles southwest of Midale.

EASTERN CANADA

Gaspe . . . In the Gaspe peninsula of Quebec, Bald Mountain 2, is drilling past lost tools at depth.

On the Galt Brook dome, Continental 1 Deep Test continues to make oil and gas from 2,794-97 ft. and is testing, and barreling the oil. Asphalt Base 1 is in hard formation below 945 ft. and continuing to make gas.

Tar Point 1 is standing below 7,000 ft., awaiting casing, with some gas flow. Quebec 2 has a small fishing job at 5,000 ft.

ARKANSAS

Mt. Holly Venture Drills Ahead in Northwest Union

In the northwestern part of Union County Murphy Corp.'s Mt. Holly wildcat, the 1 Woodward, C SW NE 22-16s-18w, is drilling ahead at 5,164 ft. near the Cotton Valley formation, possibly in. The wildcat, located in south central Arkansas, is scheduled to 7,000 ft. to test the Smackover lime which produces at Mt. Holly field.

Shows of oil in the Travis Peak have been found at the wildcat. One of these oil sands in the Travis Peak has commercial possibilities. Recovery on a 10-minute drill-stem test at 4,446-55 ft. was 3,050 ft. of gas-cut oil, 360 ft. of oil-cut salt water, and 410 ft. of oil-cut mud.

NEW MEXICO

SOUTHEAST NEW MEXICO

Eddy Wildcat Flows Gas on Test

Stanolind Oil & Gas Co. 1-AB State, Eddy County wildcat in the shallow Red Lake field, had prospects of gas-distillate production from a deep formation, probably Pennsylvanian.

First drill-stem test from 9,980-10,154 ft. was cut short in 13 minutes due to loss of a connection. Gas had surfaced in 3 minutes and was flowing to separator at the rate of 6,500,000 cu. ft. daily. There was a trace of distillate.

Gas flow increased to 13,000,000 cu. ft. daily on a 30-minute test from 10,135-10,241 ft., and recovery in the pipe was 90 ft. of distillate and 27 ft. of distillate and gas-cut mud. Operators were to drill ahead.

Delaware basin . . . Richardson & Bass 1 Cobb-Federal, 23-30s-31e, stopped drilling at 16,459 ft., in the pre-Cambrian, then plugged

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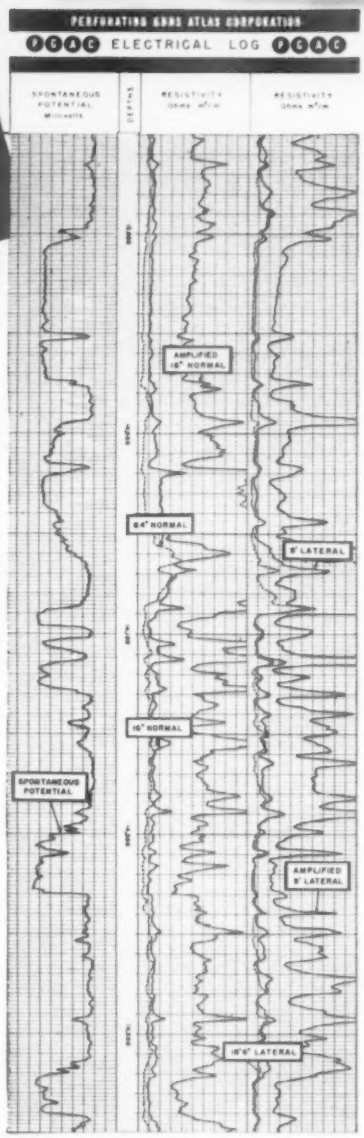

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NEW MEXICO: Hobbs, phone 3-5852 OKLAHOMA: Oklahoma City, phone CEntral 2-5342 — Pauls Valley, phone 1577 — Seminole, phone 2938.
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back to 12,573 ft. Production tests were to be made on perforations from 12,492-12,524 and 12,536-12,554 ft., in the Pennsylvanian. Lowest marker reported was the Devonian at 14,395 ft.

The same operators 1 Fidel-Federal had total depth at 13,532 ft. and was to core ahead.

Richardson & Bass 1 Harrison-Federal was drilling below 14,467 ft. in lime and shale.

LOUISIANA

NORTH LOUISIANA

Good Wilcox Show Tested In Grant Parish Wildcat

Grant Parish, along the Wilcox trend that extends through central Louisiana into southwestern Mississippi, has a prospective discovery at Bates & Cornell 1 Walter Fletcher, C SW NW SE 9-7n-4w, 1 mile northwest of Aloha townsite.

Operators are preparing to test the Wilcox sand which had oil shows on logs between 4,286 and 4,300 ft.

Map of East Central Louisiana and southwestern Mississippi Wilcox producing areas. A, B, and C point to three recent Wilcox discoveries in Concordia Parish, currently northern Louisiana's most active wildcat area.

Potential Taken at Esperance Point Well

Justiss-Mears Oil Co., Inc., and Barnett Serio have taken official potential on their 1½-mile northwest extension to Esperance Point field (C on map) in eastern Concordia Parish on the Wilcox trend of east-central Louisiana.

The extension discovery flowed 180 bbl. of 45.4°-gravity oil per day through a 9/64-in. choke. The 3 Hugh Junkin et al 1 is located in Section 1-5n-9e, 330 ft. south and 660 ft. east of the SWc Section 41. Perforations are at 6,219-23 ft. in the upper part of the Campbell zone of the Wilcox sand.

The same operators are coring for the Campbell sand at the east offset to the field extension at 4 Junkin.

Wildsville field . . . The confirmation well to the northwest extension to Wildsville field (A on map), another Concordia Parish new discovery, has been completed flowing 110 bbl. of 40.7°-gravity oil per day through a 7/64-in. choke. The Barnett Serio 1 Felder, C NW NE 12-7n-6e, is producing from the Wilds sand of the Wilcox from perforations at 5,089-90 ft.

Horseshoe discovery . . . The west offset to the recent discovery well of Horseshoe field (B on map) in Concordia Parish has been staked by Carter Oil Co. at 1 Mary Carpenter, SW SE 1-6n-7e. Horseshoe field was formerly called Buck Bayou field. The field discovery well was completed last month by Billups Bros., Vasser & Brown at 1 King, SE SE 1-6n-7e. Hunt Oil Co. is drilling 2 John Dale, Jr., SW SW 6-6n-8e, as the east offset to the field's discovery well. The discovery well flowed 163 bbl. of oil per day through a 9/64-in. choke from perforations at 5,310-15 ft. The perforations were made in the upper part of a 14-ft. net oil sand.

SOUTH LOUISIANA

New Iberville Discovery Produces Gas-Condensate

Another gas-condensate producing field, designated as "Sullivans Lake," has been opened by Union Producing Co. in Iberville Parish. Location of the discovery well, 1 Schwing, in 75-10s-11e, is approximately 6 miles north of the Whitecastle field, present nearest production.

Producing from casing perforations at 10,984-11,004 ft., the discovery well, on initial tests, flowed at the rate of 325 bbl. of condensate with 6,176,000 cu. ft. of gas daily through ⅝-in. choke with tubing pressure gaging 3,430 psi. Gravity of the condensate was 49.9°.

High Pressure Gaged in Plaquemines Discovery

Flowing pressures up to 6,000 psi. were recorded in preliminary production tests at Continental Oil Co.'s new oil discovery well on its West Delta Block 53 in the tidelands off the coast of Plaquemines Parish.

Testing Miocene sand with casing perforated at 12,344-46 ft., the well flowed 20.7 bbl. per hour through 6/64-in. choke, and 24.9 bbl. per hour through 8/64-in. choke. Gravity of the oil is 18.4°.

Flowing pressure in these tests was 5,150 psi. The higher pressure was gaged in a later drill-stem test with additional casing perforations up to 12,330 ft. This test, using an 8,000-ft. water cushion, got the cushion to the surface in 4 minutes and flowed gas, gaging the 6,000-psi. pressure within 10 minutes. When the tester was closed after 36 minutes, the well continued to flow for a short time with pressure building up to 7,300 psi.

APPALACHIAN AREA

OHIO

Gas along the west side of Reese pool was confirmed by McCall Drilling Co. 1 R. W. Leigh, Section 12, New Castle Township, Coshocton County. Clinton was topped at 3,298 ft. and at 50 ft. in, the test gaged 1,250,000 cu. ft. with drilling continuing. In the north part of the township, the Preston Oil 3 McFarland was fractured with good results. Clinton at 3,099-3,154 ft. made 240,000 cu. ft. with a showing of oil natural, and flowed 184 bbl. with 1,000,000 cu. ft. gas in 24 hours after treatment.

In Perry Township, Coshocton County, Mammoth Drilling Co. 7 Hays, Section 5, made 120 bbl. in 24 hours after fracturing sand found at 3,191-3,241 ft.

The new Shearer pool in Coshocton County has taken on an indication of importance with the completion of National Gas 1 C. G. Conrad, 2nd Qr., Bethlehem Township. Clinton sand found at 3,346-3,416 ft. with 20 bbl. natural was fractured and flowed an estimated 350-bbl. daily after being opened.

Mutual Oil Co. extended Taylor pool in Clay Township, Knox County ½ mile to the west with a combination well on 1 Rachel Elliott, Section 20. Clinton sand at 2,877-2,903 ft. made 1,000,000 cu. ft. natural with a show of oil and 80 bbl. and 225,000 cu. ft. in 24 hours after fracturing.

Mid East Oil Co. extended New Castle pool a location east with a small producer on 6 Quinn Neldon, Section 22, New Castle Township, Coshocton County. Clinton at 3,324-64 ft. made 40 bbl. in 24 hours after fracturing.

TEXAS

WEST TEXAS

Ellenburger Water Table Established in Gulf 1 Lea

After many drill-stem tests over an oil-bearing section nearly 300 ft. thick, Gulf Oil Corp. 1 P. J. Lea, Crane County wildcat, found the water table. Last test from 8,380-8,448 ft. had gas in 30 minutes, and salt water in 43 minutes, cut about 5 per cent with oil. Previous to the test a core from 8,432-48 ft. recovered 11 ft. of lime and dolomite, slightly oil stained and bleeding water. Top of the Ellenburger was 8,132 ft.

British American Oil Producing Co. 1 Millard Eidson, northwest of Penwell in Ector County, swabbed 90 bbl. of new oil in 24 hours on Pennsylvanian perforations between 7,930-72 and 7,994-8,032 ft.

Magutex outpost . . . Magnolia Petroleum Co. 1-CB Fasken, 1 mile southeast of production in the Magutex field, Andrews County, developed 8,672 ft. of gas-cut oil on a drill-stem test of the Devonian between 12,536-12,591 ft. Operators prepared to core ahead from total depth at 12,591 ft. Top of the Devonian at 12,481 ft. was about flat structurally with the field.

Northeast Andrews extension . . . Phillips Petroleum Co. 1-TT University, Section 41, recovered 10 ft. of oil, 5,465 ft. of water blanket slightly oil-cut and 1,620 ft of salt water on a drill-stem test from 13,975-14,002 ft. in the Ellenburger. Top of the formation at 13,985 ft., minus 10,952 ft., was said to be 155 ft. low to Phillips 2-CC University, discovery of the field. Operators were running electrical surveys.

Delaware basin . . . Buck Jones Drilling Co. 2 Daughtee, Reeves County wildcat 2 miles east of Orla, picked top of the Delaware lime at 3,125 ft., by samples, and was drilling ahead below 3,141 ft.

Magnolia 1 Rape flowed some gas and recovered 225 ft. of free oil on a drill-stem test between 11,098-11,188 ft. Operators were coring ahead below 11,199 ft. The well apparently was still in the Wolfcamp, topped at 10,082 ft.

TEXAS GULF COAST

Fourth North Buna Well Extends Field Westward

Productive area of the new North Buna field, in Jasper County, is being extended a 40-acre location westward with the completion by Ada Oil Co. and Hurt Oil Co., Ltd., of their 3 Hardy Richardson, which, on a pre-potential test, flowed at the rate of 184.69

bbl. of 40.2°-gravity oil per day through ⅛-in. choke under tubing pressure of 1,225 psi. with gas-oil ratio of 800 cu. ft. per barrel.

Production is from the field's 7,200-ft. Yegua sand, opposite which casing is perforated at 7,224-28 ft. The well, the fourth for the field and the third from the 7,200-ft. sand, appears to be the best so far completed on the basis of initial flows.

The new well is 933 ft. west of the discovery well, completed last January by the above companies at their 1 Richardson, which flowed 183 bbl. of 37.8°-gravity oil per day from casing perforations at 7,198-7,212 ft.

The same companies confirmed the discovery at their 2 Richardson, 1,320 ft. north of the initial producer, which flowed 140.80 bbl. of 37.5°-gravity oil per day with casing perforations at 7,213-18 ft. When this well was completed, its initial production was reported erroneously as 7 bbl. of oil per day when it should have been 7½ bbl. per hour.

The field's other well, located 690 ft. south of the discovery well, was drilled by American Republics Corp. and Houston Oil Co. at 1 Johnson fee. It was completed last March in a deeper Yegua sand with casing perforated at 7,572-79 ft. On potential gage, it flowed 38.1 bbl. of 46.2°-gravity oil per day through 9/64-in. choke.

Discovery Opens Field In Midfield Townsite

A new field, with discovery well located inside the Midfield townsite, in Matagorda County, has been opened by Roy R. Gardner, Houston independent operator. The discovery well, 1 Midfield Townsite unit, on potential gage, flowed 163 bbl. of 51.9°-gravity oil in 24 hours through ⅛-in. choke with 2,025 psi. tubing pressure and gas-oil ratio of 2,141 cu. ft. per barrel. The well, drilled to 8,880 ft., is completed in a Frio sand, opposite which casing is perforated at 8,801-15 ft.

Specific location, in the northeast corner of the townsite, is on the line between Lots 3 and 4, Block 19, I&GN Survey. It is 2½ miles southeast of the Arch field, and 2½ miles northeast of the Midfield field.

NORTH CENTRAL TEXAS

Nolan County Rates Two Discoveries

T. A. Kirk has completed 1 J. W. Lynch as an Ellenburger discovery 4 miles east of Sweetwater. Final completion gage was 149 bbl. of oil, plus 3 bbl. of water, through ½-in. choke from open hole between 6,048-6,120 ft. Location is 1½ miles north of nearest production.

An Ellenburger extension to the North Blackwell field was in prospect at Superior Oil Co. 2-30 Kinard. A test on open hole section at 6,540-72 ft. flowed 58 bbl. of oil in 13 hours.

Cisco strike . . . Jones & Stasney 1 G. W. Cochran was shut in for completion test after running production tests through various size chokes, on perforations between 4,015-23 ft. On 3/16-in. choke it flowed 6 bbl. in 1 hour, then gaged 16.5 bbl. in 1½ hours through 18/64-in. choke and 70 bbl. of oil in 12 hours through 18/64-in. choke.

Top of the Cisco was 3,090 ft. on elevation of 2,280 ft. Total depth was 6,683 ft. in the Ellenburger, which produced gas and a small amount of oil. Location of the new well is 6 miles southeast of Maryneal in 112-1A-H&TC. General Crude Oil Co. has made location for 1 G. W. Cochran as a ⅝-mile northeast offset to the discovery.

Baylor County: Burk Royalty Co. 1 F. C. Green, 2 miles southeast of Rendham, completed as a Chappel limestone discovery. Potential was 137 bbl. of 39° oil a day through 8/64-in. choke from pay at 5,412-29 ft.

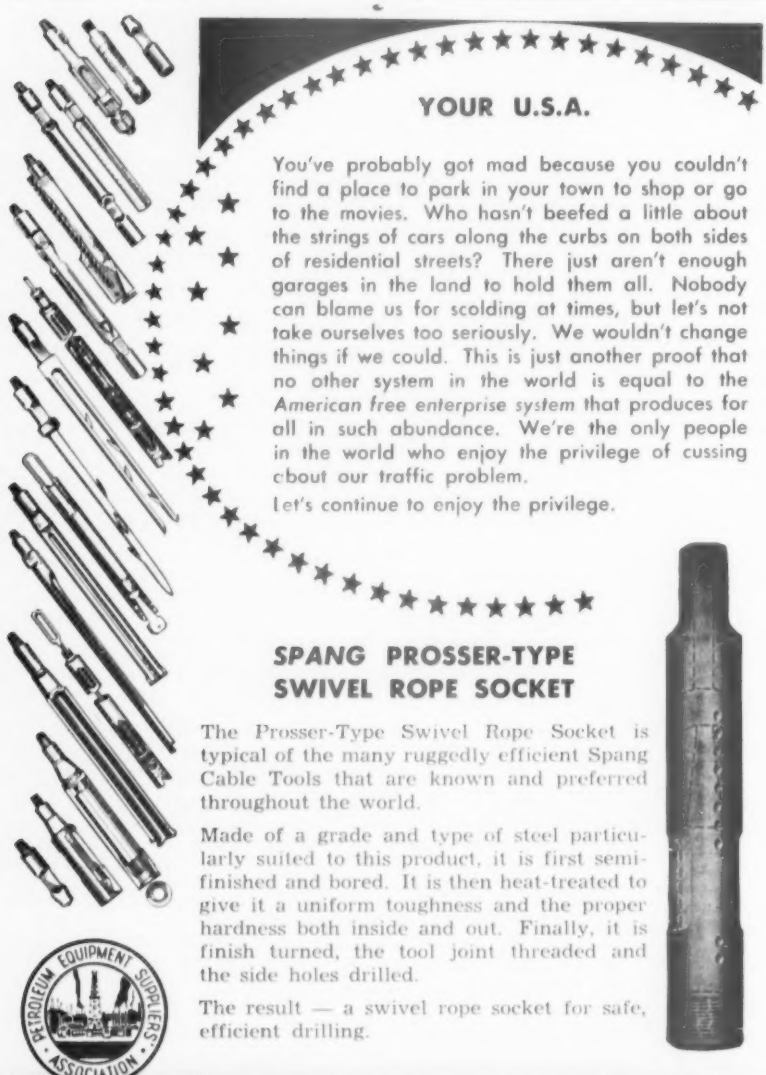
Knox County exploration . . . Humble Oil & Refining Co. will drill its 1-D McFaddin Estate, 9 miles southwest of Benjamin in Knox County, as a 7,000-ft. wildcat. Location is in 32-13-H&TC. Humble 1-C McFaddin, west of Benjamin in Section 104, was a dry hole at 6,315 ft.

Parker County . . . Humble has also announced location for a 7,000-ft. test to be drilled 4½ miles northeast of Milsap. The project will be 1 J. H. Doss in the J. H. Gaines Survey.

Young County . . . Star Oil Co. 1 Hockaday Ranch, 4 miles southeast of Graham, and some 2 miles northeast of production, completed as a flowing discovery. Potential was 58 bbl. of oil a day through ¼-in. choke from pay at 3,232-90 ft.

Novi Equipment Co. 1 J. H. Hausler, Mississippian discovery 6½ miles southwest of Spring Creek, flowed 5 bbl. of oil an hour through ⅜-in. choke from pay between 4,910-26 ft., total depth. Top of the Mississippian was 4,886 ft.

Archer County . . . The Hunter Co., Inc., 1 Adam Furr completed as a Strawn discovery, flowing 165 bbl. of oil a day through 10/64-in. choke. Pay section was perforated from 4,848-61 ft. Location is 4 miles northeast of



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SOUTHWEST TEXAS

New San Patricio Field

Big "6" Drilling Co. has opened a new oil-producing area 2 miles southwest of the East Mathis field, in San Patricio County. Its new discovery well, 1 Dix, located in Section 32, Hall Subdivision of the Welder Ranch, in the AB & M Survey 8, flowed 68 bbl. of 39°-gravity oil per day through 18-in. choke. Production is from Frio sand, opposite which casing is perforated at 5,013-18 ft. Total depth is 6,216 ft.

ROCKY MOUNTAIN

NORTH DAKOTA

Amerada To Run Casing At Fryburg Wildcat

Amerada Petroleum Corp. will run casing to present total depth of 9,396 ft. at 1 May, C NW NE 9-139n-100w, in the Fryburg area of Billings County. The operator has designated the long string of 7-in. pipe as protection casing.

No tests have been run in the well since a high pressure zone of inert gas was drilled at 7,394 ft. The well is now believed to be in Madison, although no tops have been released below Charles at 8,709 ft. Logs have been run, and unconfirmed reports of shows in cuttings from near the present depth have been circulated in North Dakota.

Amerada has reported that tests were not made due to the Minnekahta gas zone, and expects to proceed with tests following landing of casing. The well is one of the most important wildcats now under way in the Williston basin. It is about 28 miles northeast of Stanolind Oil and Gas Co.'s deep failure at 1 Brusich, SE SE SE 8-135n-98w, Slope County which was drilled last year as a joint venture with Deep Rock Oil Corp. This wildcat had important shows through Mississippian formations but fell short of commercial completion.

Fifth Failure Plugged In Croff Area

Amerada Petroleum Corp. has plugged a fifth dry hole in the Croff area of McKenzie County. The well, 1-B North Dakota, C SW SW 16-150n-95w, went to a total depth of 9,338 ft. and recovered only gas-cut sulfur water on tests. Amerada has production about 5½ miles southwest of the current failure. The Croff discovery was one of the early North Dakota successes but was completed for a relatively small potential.

MONTANA

Richland County Strike Still Testing

Sun Oil Co. and Phillips Petroleum Co. are preparing to make a third set of perforations in the approximate zone 12,585-605 ft. at 1 Dynneson, C SW NE 32-24n-58e, in the Brorson area of Richland County. The well flowed 206 bbl. of oil daily on early tests of this zone, before perforations became plugged. After reperforation the well made varying recoveries on tests ranging from 79 bbl. of clean oil in 24 hours to 126 bbl. of fluid per day, 35 per cent salt water.

Up-hole shows in Mississippian in this wildcat have not been tested since casing was run. The formation had considerable staining and saturation, considered by observers to be comparable to that found in Amerada's North Dakota discovery. Drill-stem tests during drilling did not yield commercial recoveries, and the possible effect of acid on the formation is of keen current interest to operators in the area.

WYOMING

North Sand Draw Wildcat Completed In Tensleep

Sinclair Oil & Gas and Stanolind Oil & Gas have completed their joint discovery at 1 Unit, SW SE SW 21-33n-95w, in the North Sand Draw unit, Fremont County for a flow gage of 136 bbl. of oil per day from Tensleep. The wildcat went to a total depth of 11,500 ft. and was plugged back for completion to 10,818 ft. The Tensleep section was well developed, but was for the most part hard and tight. During drilling the well was cored 33 separate times for a total of 671 ft. and more than 40 drill-stem tests were run. Early swab tests recovered oil at the rate of 350 bbl. per day.

South Sand Draw Gas Discovery Apparent

Sohio Petroleum Co. is drilling below 5,078 ft. at 1 Unit, SE NE SE 32-26n-95w, southeast of Sand Draw field in Fremont County, after recovering gas at the estimated rate of 3 to 5 million cu. ft. per day from the interval 5,043-73 ft. The wildact is a scheduled 8,000 ft. test to Tensleep, and the producing formation has not been identified. Top of

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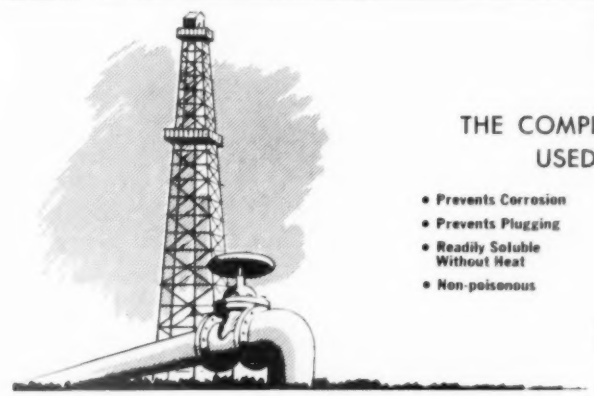

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First Frontier was logged at 3,992 ft. The test of the interval above was of 1-hour duration, and that was gas and a spray of distillate at the surface after 3 minutes. Pipe recovery was 10 ft. of distillate-cut mud and 90 ft. of mud-cut water. Flowing pressure was 750 psi., shut in pressure 1,600 psi. The well is approximately 1¾ miles southeast of a discovery by Sand Draw Oil Co. in NE SW NE 26-32n-95w which was completed in 1946 for a gage of 20 million cu. ft. per day from the First Frontier which was topped at 4,015 ft.

Weston County Stepout Flows At High Rate

R. L. Manning, Denver independent has tested a flow of 70 bbl. of oil per hour from 1 Sedgwick, NE SW SE 23-42n-66w, in the Black Thunder Creek area of Weston County. Test was of a Newcastle zone from 6,861-92 ft., with top of Newcastle at 6,848 ft.

The well is about ¾ mile south of the discovery in this area at Voss Oil Co.'s 1 Scott, SW NW NE 23-42n-66w, which was completed for a pump gage of 250 bbl. of oil daily. An offset to the Voss discovery was completed for a pump potential of 150 bbl. daily.

The operator has staked location for an offset to 1 Sedgwick. This area has been of considerable interest since earlier this year which Big Horn-Powder River Corp. and J. D. Sprecher tested 1 Wakeman, 1-42n-66w for a flow of 975 bbl. of oil daily through 20/64-in. choke. This discovery started the current program of drilling southwest of previous production which was largely developed during the very active period of the immediate postwar years.

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UTAH

Southeastern Utah Gas Discovery Reported

Dan Danvers, San Antonio independent has reported discovery of gas at an important southeastern Utah wildcat in central San Juan County. The well is 1 Government, C SW SW 1-37s-18e (SLM) along the north end of the Bullet Springs anticline. Reports indicate that the well blew out at about 3,253 ft., after operator had logged hard lime in samples. Volume of gas has not been estimated, since the operator lost the rig to fire when the wildcat blew out and is now moving in rotary tools for deepening.

The wildcat is about 20 miles northwest of areas of principal interest to bidders during the recent sale of Indian lands in the Four Corners area of Utah and Arizona which was the largest sale ever held by the Indian service.

COLORADO

Southwest Yenter Wildcat Flows At Good Hourly Rate

Falcon Seaboard Oil Co. estimated a flow of 5 bbl. of oil per hour on test of 1 Thompson, SE SE SE 7-8n-54w, southwest of Yenter pool in Logan County. Test was of the "J" Sand interval 5,416-30 ft. and tool was open for 1½ hours. There was gas at the surface in 8 minutes, and the well unloaded at the end of the test. Flowing pressure was 480-1,080 psi. The operator is coring below 5,430 ft. The well is 1½ miles southwest of production in Yenter field.

Second Greenhorn Success for Denver-Julesburg Basin

Sherrod & Apperson of Tulsa recovered 500 ft. of clean oil and 400 ft. of heavily oil-cut mud on drill-stem test of the Greenhorn at 2 County, SW NW SW 1-3n-61w in the Empire area of Weld County. Complete details of the test have not been reported by the operator, but the well is the second to produce from this formation in the basin. Greenborn was previously considered devoid of productive possibilities. Sherrod & Apperson completed the discovery well in this area several weeks ago for a final pump gage of 25 bbl. of oil daily. Initial tests of the discovery well had flowed at the rate of 6 bbl. of oil per hour.

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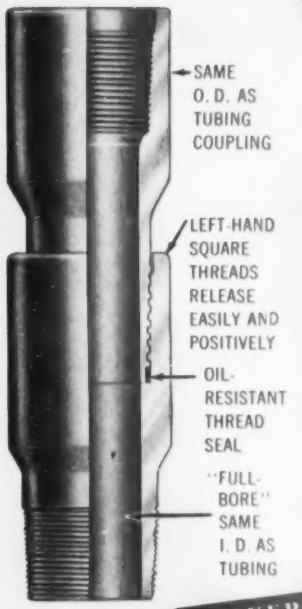
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KENTUCKY

EASTERN KENTUCKY

In Carter County, 3-U-79 and located 6½ miles south of the county seat of Grayson, Wolfe Creek Oil Co. have a dry hole at their 1 Violet Thomas. This wildcat test was drilled to a total depth of 998 ft. and through the Berea (Mississippian) with only slight shows of oil. Big lime was topped at 289 ft. and Weir sandstone at 737 ft.

In Harlan County, 3-F-76, Lowry Oil Co. is drilling at 2,550 ft. at their 1 Inter-Mountain Coal and Lumber Co. Well is located approximately 11 miles northeast of Harlan, the county seat. Operators are bottomed in Red Rock and are trying for a second time to cement off a bad cave.

In Bell County, 15-D-60, J. M. Brooks has a dry hole at his wildcat 2 Creech. Drilled to a total depth of 2,366 ft., test had only shows of oil and gas in noncommercial quantities at 2,224 ft. and 2,229 ft. in the Big lime formation.

MISSISSIPPI

Second Well Confirms Aberdeen Gas Discovery

Discovery early this year by Shell Oil Co. of gas production in the Aberdeen area of western Monroe County, in the Black Warrior basin, has been confirmed with the completion of the company's second well.

The new well, 1 Holmes Unit B, producing from the Chester Sanders zone, pay horizon

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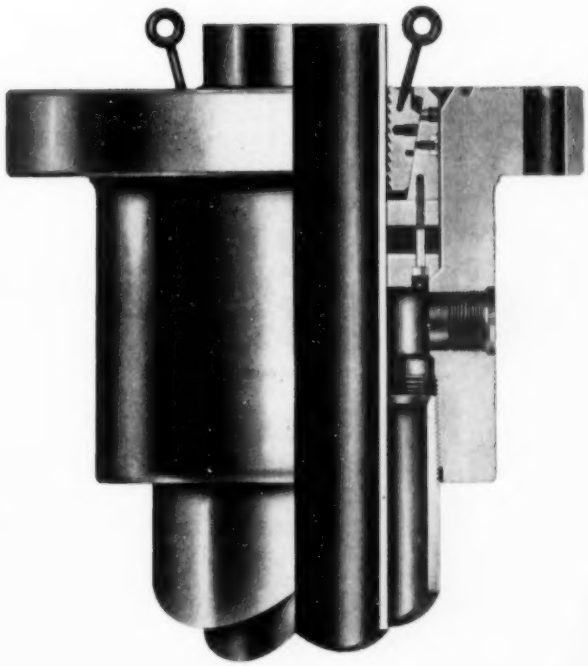

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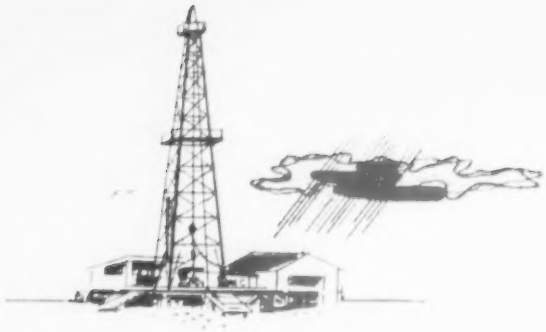

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of the discovery well, opposite which casing is perforated at 3,520-40 ft., flowed at the rate of 4,000,000 cu. ft. of gas per day through 26/64-in. choke with tubing pressure of 1,063 psi. Calculated open-flow capacity is 13,000,000 cu. ft. per day.

The well is the northwest diagonal offset to the discovery well, which produced at the rate of 4,500,000 cu. ft. of dry gas per day.

Aberdeen was the second in the succession of 4 Paleozoic gas fields which have been opened in the active exploration which has been under way in the Black Warrior basin of northeastern Mississippi and northwestern Alabama the past year.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS

Aransas County: C. G. Glasscock and Humble Oil & Refining Co. 2 State, Tract 11, Copana Bay. IP 119.02 BOPD, 7/64-in., 42.3°, casing perforations 6,756-61 ft. TD 7,296 ft. (New pay in North Fulton Beach Segment B field.)

Atascosa County: C. G. Dunwoody 1 Jahn, Anson G. Neal Sur., A-643. Dry. TD 5,413 ft.

Bexar County: W. W. Kelly and H. A. Pagenkopf 1 Centelli, D. LaSoya and M. de Luna Sur., A-7 and A-8. Dry. TD 2,677 ft. in Edwards lime. Navarro 1,250 ft., chalk 2,430 ft., Buda 2,595 ft., Edwards 2,660 ft.

Caldwell County: C. E. Starr 1 Loredo Hemphill Macket et al, Gideon Pace Sur., A-230. Dry. TD 2,316 ft.

Duval County: John F. Camp 3 Miller, Diego Hinojosa Grant, A-629. Dry. TD 3,832 ft.

Pontiac Refining Co. 1-A Miller, Diego Ynojosa Grant. Dry. TD 4,500 ft.

Gonzales County: Lone Star Producing Co. 1 Cox, Sara Seely Lge., A-60. Dry. TD 1,463 ft.

Thomas-Singleton-Fenner 1 W. G. Johnson, Jr., Allan B. Williams Sur., A-79. Dry. TD 2,550 ft.

Hidalgo County: Heep Oil Corp. et al 1 Ansaldua, Porcion 58. Dry. TD 7,526 ft.

Houston Oil Co. of Texas and American Republics 16 Temple West, Porcion 74. IP 40.02 BOPD, ⅛-in. Mission sand, 5,766-70 ft. (casing perforations). TD 6,257 ft. (New pay in Tabasco field.)

Jim Hogg County: Humble Oil & Refining Co. 3-B Atwood, San Antonio Viego Grant. Dry. TD 3,700 ft.

Jim Wells County: Morris Cannan 1-A Luby heirs, Los Presenos de Abajo Grant. Dry. TD 6,100 ft.

Sid Katz and W. E. Fox 1 Ingram, Scott Subd., Benton Ranch. IP 125.08 BOPD, ⅛-in., 38.5°, Frio-Middle King sand 5,606-08 ft. (casing perforations). TD 6,508 ft. (New field.)

McMullen County: Kirkwood & Morgan, Inc., and Standard Oil Co. of Texas 1 Nueces, Theodore Roziene Sur. 166. Dry. TD 5,168 ft.

Sunray Oil Corp. 1 Price, AB&M Sur. 53, A-28. IP 18,000 M.c.f. daily, open flow, casing perforations 7,848-67 ft. TD 8,050 ft. (Extends Jake Hamon field.)

Milam County: Milam Producing Co. 1 Fuller, Francisco de la Rio Sur. Dry. TD 2,805 ft.

Nueces County: Phillips Petroleum Co. 1-A State, Tract 70, Corpus Christi Bay. Dry. TD 6,999 ft.

San Patricio County: Arnold O. Morgan 2-F Welder, Welder Ranch Subd. Dry. TD 8,033 ft.

Plymouth Oil Co. 1 Smith, George H. Paul Subd., Welder Ranch. Dry. TD 7,081 ft.

Ben F. Vaughn, Jr., 1 Picha, Section 54,

WILDCAT COMPLETIONS

George H. Paul Subd. IP 161.61 BOPD, ⅜-in., 42.5°, casing perforations 7,300½-02½ ft. TD 7,900 ft. (New field, or extends South Taft field.)

Webb County: W. Earl Rowe and Glen Mortimer, Jr., 2 Moos, CCSD&RGNG Sur. 21. Dry. TD 4,228 ft.

Willacy County: George C. Schoonmaker 1 Kembrick et al, Jan Juan de Carricitos Grant. Dry. TD 9,841 ft.

Wilson County: Jake L. Hamon 1 McCracken, Luis Manchacna Grant, A-18. Dry. TD 4,150 ft.

H. H. Howell 3-A Weinert, V. Bennett Sur. 25. Dry. TD 4,826 ft.

T. E. Talley 1 Adema, S. & J. Arocha Grant. Dry. TD 646 ft.

TEXAS GULF COAST

Brazoria County: Stanolind Oil & Gas Co. 2 Hawley, L. F. Tomlinson Sur., A-374. Dry. TD 14,001 ft.

Colorado County: Tennessee Production Co. 2-A Glasscock, BBB&C Sur., A-114. IP 77.74 BOPD, 8/64-in., 38.0°, casing perforations 4,530-38 ft. TD 9,620 ft. (New pay in Glasscock field.)

DeWitt County: Holmes Drilling Co. and Thomas Brothers 1 Schroeter, J. T. Tinsley Sur., A-455. Dry. TD 7,616 ft.

Goliad County: Heep Oil Corp. et al 1 Yanta, Maria de Jesus Barvo Sur., A-51. Dry. TD 8,503 ft.

Hardin County: Chance Drilling Co., Inc., 2 Nona Mills, I. D. Hamilton Sur., A-249. Dry. TD 9,760 ft.

General Crude Oil Co. et al 1-C Kirby, Joseph Carriere Sur., A-6. Dry. TD 9,515 ft.

Kirby Petroleum Corp. 1 Sterenberg et al, H&TB Sur., A-690 ft. Dry. TD 7,915 ft.

Jackson County: Union Sulphur & Oil Corp. 1-A I. Ranch, Juan Maldonada Sur., A-219. Dry. TD 9,208 ft.

Jefferson County: BBM Drilling Co. 1 Cicero, C. Williams Sur., A-59. Dry. TD 6,862 ft.

Live Oak County: F. B. Cochran, Jr., 1 Stephens, Simmons Subd., Sur. 74. IP 13,000 M.c.f. daily and 130 BCPD, Queen City 5,057-63 ft. (casing perforations). TD 5,065 ft. (New field.)

Harris S. Stahl 1 Mussman, Owen Gaffney Sur., A-186. Dry. TD 3,593 ft.

Matagorda County: Roy R. Gardner 1 Midfield Townsite unit, I&GN Sur. 6, Block 8, A-289. IP 163 bb BOPD, ⅛-in., 51.9°, casing perforations 8,801-15 ft. TD 8,880 ft.

Lenior M. Josey, Inc., 1 Pierce est., B. Rawls & O. H. Stout Sur., A-82. Dry. TD 9,223 ft.

Montgomery County: The Texas Co. 1 Budde, A. W. Springer Sur., A-490. Dry. TD 9,520 ft.

Victoria County: Continental Oil Co. 1 Stubblefield, Polito Castillo Sur., A-17. Dry. TD 6,609 ft.

EAST TEXAS

Ellis County: L. D. Cain 1 F. W. Patak, BBB&C Sur., 1 mi. SE Ennis. Dry. TD 3,675 ft.

Hill County: R. J. McMurrey 1 J. P. Riley, Sec. 21, Tyler CSL, A-893. Dry. TD 1,200 ft.

Hopkins County: Crown Central Petroleum Corp. 1 V. O. Wells, John F. Keller Sur., A-534. Dry. TD 7,299 ft., elev. 470 ft., Travis Peak 6,945 ft.

Hunt County: D. S. Hager and R. S. Peveto 1 Florence Alexander, Benjamin Watson Sur., A-1106. Dry. TD 4,576 ft.

Lamar County: F. B. von der Hoya 1 Lee Caviness, J. V. Pitts Sur. Dry. TD 1,200 ft.

Smith County: Fleming & Whiteley 1 I. Yarbrough, Thomas Burbridge Sur., A-71. Dry. TD 6,003 ft.

TEXAS PANHANDLE

Childress County: Wrightsman Oil Co. and Cosden Petroleum Co. 1 T. L. Maloy, 417-H-W&NW. Dry. TD 5,940 ft.

Roberts County: Cabot Carbon Co. 1 J. G. Morrison, 12-C-G&M. Dry. TD 6,996 ft., elev. 2,771 ft., Douglas 5,762 ft.

WEST CENTRAL TEXAS

Brown County: Dunn Craig 2 R. E. George, Blk. 11, Sec. 161, White Sur. IPP 15 BOPD, 44°, pay 1,518 ft. TD 1,541 ft.

Mayhew Machine Co. 1 O. R. Windham, HT&B Sur. 31. Dry. TD 2,267 ft.

Callahan County: Jack Caudle 1 Jack Caudle, 7-D-SPRR. Dry. TD 2,007 ft.

Harry Kahn 1 Harold Morgan, Sec. 19, Bayland Orphan Asylum Lands. Dry. TD 3,162 ft.

Neeld & Hood Drilling Co. 4 Olivena Loven, G. W. Denton Sur. 363. IPP 75 BOPD, 42°, pay 1,650 ft. TD 1,707 ft.

Coleman County: Anzac Oil Corp. 1 Josephine Ballard, Sec. 713, D. W. Cloud Sur. IP 65.7 BOPD, ¾-in., 44°, pay 2,433 ft. TD 2,443 ft.

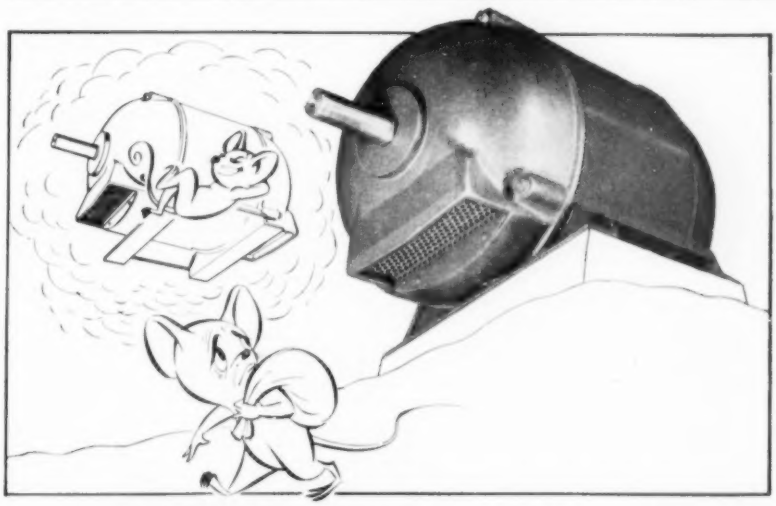
J. Holt Jowell 1 R. R. Stubblefield, Sec. 706, T. Hayes Sur. Dry. TD 3,162 ft.

Murray Petroleum Co. 1-A Jack Ewing, 11-1-GH&H. Dry. TD 2,452 ft.

Haynes B. Ownby Drilling Co. 1 L. G. Morris, 33-2-GH&H. Dry. TD 3,460 ft.

Eastland County: Nelwyn Oil Co. 1 E. Freyschlag, 22-1-T. Foster Sur. Dry. TD 3,710 ft.

Fisher County: Leigh & Scott L. Taliaferro 1 Claud Cross, 12-20-T&P. Dry. TD 5,640 ft.



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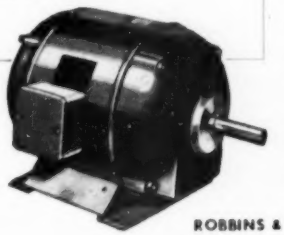

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WILDCAT COMPLETIONS

Jones County: Andree Drilling Co. 1 J. L. Crow, Lot 5, Goliad CSL Sur. 360. Dry. TD 3,510 ft.

Miami Operating Co. 2 J. E. Boaz, J. Wall Sur. 272. Dry. TD 4,128 ft.

Onyx Oil Co. and Lester & Duffield 2 A. L. Spraberry, Sec. 41, Orphan Asylum Lands. IPP 63.9 BOPD, 40°, pay 1,898-1,909 ft. TD 2,370 ft.

Paul G. Teas 1 Mrs. Pearl Milstead, 6-359-Goliad CSL. IP 90.6 BOPD, 14/64-in., 39°, pay 2,963 ft. TD 2,978 ft.

The Texas Co. 1 Alma Polk Trust, Sec. 3, Bushell Subd., D&DA Sur. IPP 69.7 BOPD, 38°, pay 2,100 ft. TD 2,108 ft.

Stonewall County: Texas-Pacific Coal & Oil Co. 1-A Gholson, 80-D-H&TC. Dry. TD 6,564 ft., elev. 1,736 ft., Mississippian 6,318 ft., Ellenburger 6,509 ft.

Taylor County: West Central Drilling Co. 1 J. W. Seymore, 4-4-B&C. Dry. TD 5,520 ft.

NORTH TEXAS

Archer County: Archer Drilling & Production Co. 1 Turbeville, T. P. Glass Sur. 182. Dry. TD 1,290 ft.

Archer Drilling 2 Turbeville, T. P. Glass Sur. 182. Dry. TD 1,286 ft.

R. W. Darden 1 Baldwin-Lovett, Blk. 8, A-1306, BBB&C. Dry. TD 1,364 ft.

Darden 1-A Richardson Trust, Blk. 23, J. Scott Sur., A-374. Dry. TD 1,296 ft.

Darden 1-C Richardson Trust, Blk. 16, J. Scott Sur., A-374. Dry. TD 1,395 ft.

Darden 1-D Richardson Trust, Blk. 11, J. Scott Sur., A-374. Dry. TD 1,268 ft.

Grayson County: Larson & Thomas 1 Mrs. Joanna Moss, A. Humes Sur., A-522. IP 165 BOPD, 15/64-in., 32°, sand pay 7,560-90 ft., elev. 840 ft. TD 7,709 ft.

Jack County: Neeld & Hood Drilling Co. 2-C Prideaux, SPRR Sur., A-577. IPP 10 BOPD, 32°, pay 600 ft. TD 612 ft.

Neeld & Hood 1-D Prideaux, SPRR Sur., A-577. IPP 20 BOPD, 32°, pay 591 ft. TD 594 ft.

Star Oil Co. 1 L. A. Worthington, SA&MG Sur., A-589. IP 139 BOPD, 16/64-in., sand pay 2,140-46 ft. TD 2,212 ft.

The Texas Co. 1 U. D. Johnson, Sion Pritchard Sur., A-458. IP 18.3 BOPD, 12/64-in., 49°, pay 5,564-76 ft. TD 5,735 ft.

Knox County: Thos. D. Humphrey & Sons 1 J. W. Howell, 58-13-H&TC. Dry. TD 5,855 ft. in Mississippian lime.

Montague County: Miami Production Co. 1 Joe Benton, 19-A421-Limestone CSL. Dry. TD 6,338 ft.

Wilbarger County: Dublin-Kiel 1-E Waggoner, on division line of Sur. 48 and Sec. 35, Blk. 3, H&TC. Dry. TD 2,003 ft.

Young County: Glenn Atchley 1 Katherine Atchley, Blk. 1, I. Holeman Sur. Dry. TD 1,290 ft.

Farmer & Darden 1 Escue, Blk. 1591, A-933, TE&L Sur. IPP 32 BOPD, 39°, pay 1,190 ft. TD 1,192 ft.

Henry Grace Production Co. 3 Graham Stewart, Tayler Rose Sur., A-1653. Dry. TD 829 ft.

Rocket Oil Co. 1 W. E. Hartey, C. P. Benson Sur., A-1569. IP 78.9 BOPD, 16/64-in., 40°, pay sand 3,148-58 ft. TD 3,161 ft.

WEST TEXAS

Crockett County: Sinclair Oil & Gas Co. 2 Nettie Holt, 61-OP-GC&SF. Dry. TD 1,565 ft.

Thomas & Doss 1 Maggie S. Neal, 58-BB-TCRR. Dry. TD 2,712 ft.

Gaines County: F. R. Jackson 1 Seaboard-Bain, 280-G-Waxahachie Tap RR Sur. Dry. TD 5,632 ft.

Garza County: Duncan Drilling Co. 1-A Kirkpatrick, 8-2-GH&H. Dry. TD 3,010 ft.

King County: Shell Oil Co. 1-C Burnett Estate, 9-T-T. A. Thompson Sur. Dry. TD 6,400 ft., elev. 1,774 ft., Strawn 5,236 ft., Mississippian 5,950 ft., Ellenburger 6,233 ft.

Mitchell County: Sohio Petroleum Co. 1 Paris Yarborough, 67-25-T&P. Dry. TD 7,371 ft., elev. 2,221 ft., Mississippian 7,308 ft., Ellenburger 7,362 ft.

Pecos County: Abernathy Drilling Co. 1 G. Lehman Est., 107-8-H&GN. Dry. TD 68 ft.

Runnels County: Thos. D. Humphrey & Sons 1 W. J. Thomas, Carl Floede Sur. 392, A-188. Dry. TD 5,668 ft., elev. 1,726 ft., Ellenburger 5,133 ft., Hickory sand 5,630 ft.

Inca Drilling Co. 1 Walter Adami, F. J. Ford Sur. 2. Dry. TD 3,951 ft.

Schleicher County: Richard King Jr. 1 1 Otto Williams, 16-1-GH&SA. Dry. TD 5,990 ft., elev. 2,222 ft., Ellenburger 5,542 ft.

Tom Green County: W. C. Kinkel 2 Alton Hall, Marion Gage Sur. 81. Dry. TD 1,088 ft.

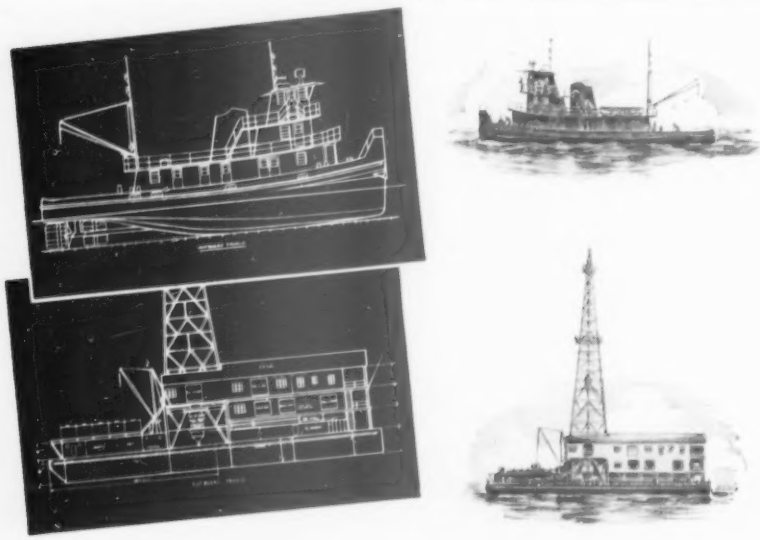
Upton County: Forest Oil Corp. 1-M TXL, 39-31-T4S-T&P. Dry. TD 10,851 ft., elev. 2,894 ft., Strawn 10,365 ft., Bend 10,645 ft.

SOUTHEAST NEW MEXICO

Eddy County: J. Mask 1 Little-Federal, 28-18s-31e. Dry. Td 3,952 ft.

ILLINOIS

Bond County: J. F. Dunhill 1 Welch, SE NW SW 34-4n-2w. Dry. TD 2,654 ft.



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WILDCAT COMPLETIONS

E. Smith 1 Harnetiaux, NW NW SE 1-5n-2w. Dry. TD 1,312 ft.
Walter Dnucan 1 Turner, SE SE SE 20-6n-3w. Dry. TD 2,325 ft.
Clark County: B & G Oil Co. 2 Wells, SE SW SE 13-9n-13w. Dry. TD 872 ft.
E. Zink 3 Borger, SW SE NW 25-12n-14w. Dry. TD 530 ft.
Clinton County: R. H. Robben 1 Hustedde, NW SW NW 23-2n-3w. Dry. TD 1,134 ft.
Edwards County: Arrow Drilling Co. 1 Redpath, SW SE NW 19-1s-11e. Dry. TD 3,260 ft.
Stanford Petroleum Co. 1 Blakney, NW NW NE 29-1n-14w. Dry. TD 3,188 ft.
Madison County: Robert McDaniel 1 Newton, NW SE NW 10-5n-5w. Dry. TD 1,969 ft.
Wayne County: A. J. Slagter Jr. 1 Cunningham SW SE NE 19-2s-7e. Dry. TD 3,388 ft.
White County: C. E. Brehm 1 West, NW NE NW 5-7s-9e. Dry. TD 3,074 ft.

INDIANA

Dubois County: H. A. Johnson 1 Menke, NW NE NE 30-3s-5w. Dry. TD 1,125 ft.
Knox County: W. W. Toler 1 Vieke-Vance-Miller, NE SE NE 18-2n-10w. Dry. TD 1,905 ft.
Morris Johnson 2 Klein, Sur. 32-3n-11w. Dry. TD 1,928 ft.
Martin County: Finch & Dornon 1 Baker, SE NW SE 31-5n-4w. Dry. TD 225 ft.
Pike County: J. O. Bowen 1 Montgomery, NE NE NE 9-2s-8w. Dry. TD 1,454 ft.
Buchman & O'Neal 1 Brenton, NE NW NW 18-1s-8w. Dry. TD 1,646 ft.
Posey County: W. C. McBride 1 Happe, SW NW NE 29-5s-12w. Dry. TD 2,850 ft.
V. R. Gallagher 6 New Harmony Realty, SE SE NW 17-5s-14w. Dry. TD 3,060 ft.
Spencer County: F. L. Beard 1 Abshier, SE SW NE 27-7s-7w. Dry. TD 1,630 ft.
Vanderburgh County: Burr Lambert 1 Knapp, NW SE NW 7-5s-11w. Dry. TD 2,325 ft.

KENTUCKY

Henderson County: R. E. Hupp 1 Hancock-Nichols, NW SW NE 5-O-22. Dry. TD 2,723 ft.
Todd County: United States Oil Co. 1 Harrison, NW SW SE 1-E-28. Dry. TD 2,272 ft.

MICHIGAN

Mecosta County: C. W. Coilin & Granville C. Berlin 1 Mecosta Lakes et al, SW SW SE 17-14n-8w. IP 4.77 M.c.f. daily. Michigan Stray sand 1,320 ft. Perforated pay 1,314-26 ft. with 150 shots. TD 3,690 ft. (dry in Dundee) PBTD 1,543 ft. (May be extension of Austin Stray sand gas storage reservoir.)

FLORIDA

Hendry County: Commonwealth Oil Co. 1 Red Cattle, SE SE NE 13-45s-28e. Dry. TD 6,093 ft. Elev. 49 ft., Chalk 5,596 ft., lower Cretaceous 5,760 ft.
Walton County: A. R. Temple 1 Harbeson, C SW NW 27-4n-20w. Dry. TD 5,124 ft. Elev. 250 ft., Eutaw 3,966 ft., marine Tuscaloosa 4,435 ft., lower Tuscaloosa 4,694 ft., lower Cretaceous 5,018 ft.

ALABAMA

Houston County: R. W. Williams 1 Whitfield, C NW SW 18-3n-26e. Dry. TD 6,007 ft. Elev. 270 ft., Eutaw 2,510 ft., lower Tuscaloosa 3,151 ft., lower Cretaceous 3,280 ft.
Monroe County: Sterrett Proctor and I. P.

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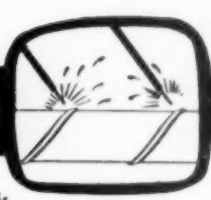

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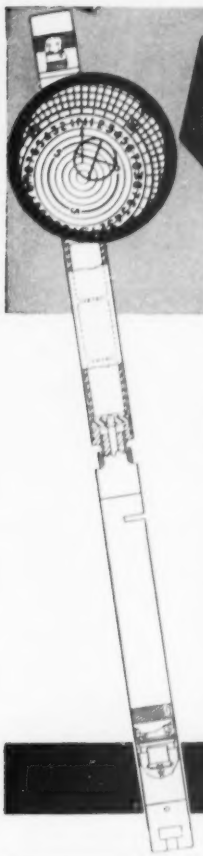

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The Bowen Line Wiper is available in sizes for all commonly used drill pipe and tubing connections. Order yours today!

SR BOWEN CO

WILDCAT COMPLETIONS

and Fred La Rue 1 Mosley, C NW NW 3-7n-8e. Dry. TD 4,210 ft. Elev. 332 ft., Midway 1,126 ft., Chalk 1,575 ft., Eutaw 2,825 ft., marine Tuscaloosa 3,838 ft., Pilot sand 3,962 ft.

Pike County: R. W. Williams 1 Davis, C SE SE 23-12n-21e. Dry. TD 1,520 ft.

MISSISSIPPI

Adams County: B. Serio and Justiss & Mears Oil Co. 2 Reynolds, 27-5n-1w. Dry. TD 7,027 ft. Elev. 100 ft., Wilcox 4,693 ft., base Baker shale 6,448 ft.

Marion County: Mobile Drilling Co. 1 Martin, NE NE SW 26-2n-18w. Dry. TD 9,486 ft. Elev. 126 ft., Sparta 2,580 ft., Wilcox 3,113 ft., Chalk 6,810 ft., lower Tuscaloosa 8,935 ft.

SOUTH LOUISIANA

Iberville Parish: Union Producing Co. 1 Schwing, 75-10s-11e (6 miles north of Whitecastle). IP 26,000 M.c.f. daily and 320 BCPD, 5/16-in., 49.9°, casing perforations 10,984-11,004 ft. TD 11,182 ft. (New field).

Jefferson Parish: Humble Oil & Refining Co. 1 Wild et al, 32-10s-4w. Dry. TD 14,507 ft.

Jefferson Davis Parish: Shell Oil Co. 2 Denny, 8-9s-6w. IP 121 BCPD and 4,919 M.c.f. daily, 17/64-in., 52°, casing perforations 9,447-52 ft. TD 9,699 ft. (New pay in Iowa field.)

St. Bernard Parish: Shell Oil Co. 1 State, Lease 2254, Block 40, Chandeleur Sound. Dry. TD 10,035 ft.

Terrebonne Parish: The Texas Co. 2 Continental, 29-18s-14e. IP 3,897 M.c.f. daily and 54 BCPD, 16/64-in., 57.9°, casing perforations 6,874-83 ft. TD 12,621 ft. (New pay in Bayou Penchant field.)

NORTH LOUISIANA

Caldwell Parish: D. F. Vasser et al 1 Leiderman-Howard, C NE NE NE 13-14n-4e. Dry. TD 5,110 ft. Paluxy 5,050 ft.

Concordia Parish: Barnett Serio et al 3 Junkin heirs, 1-5n-9e. IPF 180 BOPD, 45.4°, Wilcox 6,218-22 ft. TD 7,010 ft. (Discovery tentatively called North Esperance Point.)

E. C. Wentworth et al 1 Brown "A," 35-8n-9e. Dry. TD 5,835 ft. Base Nebo 4,850 ft.

Natchitoches Parish: Kirby Petroleum Co. et al 2 Bentley Lumber Co., C SE SW 29-6n-4w. Dry. TD 5,612 ft. Wilcox 3,165 ft.

Red River Parish: E. F. Neely Well Servicing Co. 1 Dupree, 1,695 ft. S and E of NWc 5-12n-8w. Dry. TD 3,309 ft.

Tensas Parish: J. R. Butler et al 1 Yourtee-Bagnell unit, 17-11n-11e. Dry. 8,767 ft.

ARKANSAS

Drew County: Doc Reed 1 Fee, 750 ft. N and 400 ft. W SEc NE NE 5-13s-7w. Dry. TD 2,380 ft.

Union County: Curtis A. Kinard et al 1 Johnson "A," C W½ NW SE 1-18s-17w. Dry. TD 3,460 ft.

Burnett Producing Co. 1 Lewis "A," 30-16s-17w. Dry. TD 4,602 ft.

OKLAHOMA

Atoka County: Buck Drilling Co. 1 Melton, SE SE NW SW 35-1n-14e. Dry. TD 1,000 ft.

Coal County: The Texas Co. 1 Hodges, NE NE NE SE 6-1s-10e. Dry. TD 7,850 ft.

Garvin County: Seaboard Oil Co. 1 C. B. Goddard Investment Co., NW NW SE 35-1n-3w. Dry. TD 4,500 ft.

Hughes County: W. A. Delaney, Jr. 1 Scales, SW SE SW 5-5n-9e. Dry. TD 2,927 ft.

Jackson County: Suntex 1 Taylor, SW NE NE NW 35-4n-20w. Dry. TD 835 ft.

Jefferson County: Christie Stewart Drilling Co. 1 Johnson, NE NE SE 23-3s-5w. Dry. TD 2,898 ft.

Mack Oil Co. 1 Harris, NW NW SE 8-6s-8w. Dry. TD 5,010 ft.

Lincoln County: F. A. Gillespie & Sons Co. 1 McNabb, NW SW NW 35-12n-6e. Dry. TD 3,608 ft.

Logan County: R. M. Jordan 1 Chesnut, NE NE SW 13-15n-1w. Dry. TD 5,921 ft.

Harper-Turner 1 LeMaster, NE SE SW 28-15n-2w. IPF 70 BOPD, Bartlesville 5,827-37 ft., 6,500 M.c.f. of gas. TD 6,056 ft.

Wayne R. Abbott and Cities Service Oil Co. 1 Wrobbel, NE NW NE 5-18n-2w. Dry. TD 5,928 ft.

Osage County: B. R. Albert 1 Osage, SE SE SW 5-23n-6e. Dry. TD 3,025 ft.

V. D. Watts 1 Osage, SW SE SE 22-25n-10e. Dry. TD 1,980 ft.

Wilcox Oil Co. 1 Osage, NE SW NE 15-27n-9e. Dry. TD 2,395 ft.

Pontotoc County: Roy G. Steele 1 Pritchett, NW NW NE 32-3n-4e. Dry. TD 2,750 ft.

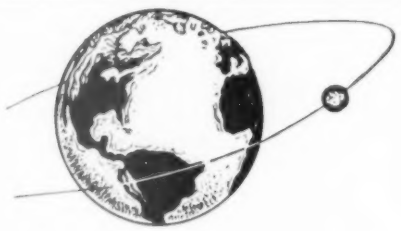
KANSAS

Barber County: Palmer et al 1 Schupbach, SE SW NE 15-34s-13w. Dry. TD 5,330 ft.

Barton County: F. E. Lockhart and Oil Trading 1 Deines, SE SE NE 2-17s-15w. TD 3,558 ft.

Petroleum, Inc. 1 Essmiller "C," NW SW SW 13-19s-14w. IPP 208 BOPD, Lansing-

(Continued on page 388)



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is giving the best performance

at less cost per foot!

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Dallas 1, Texas

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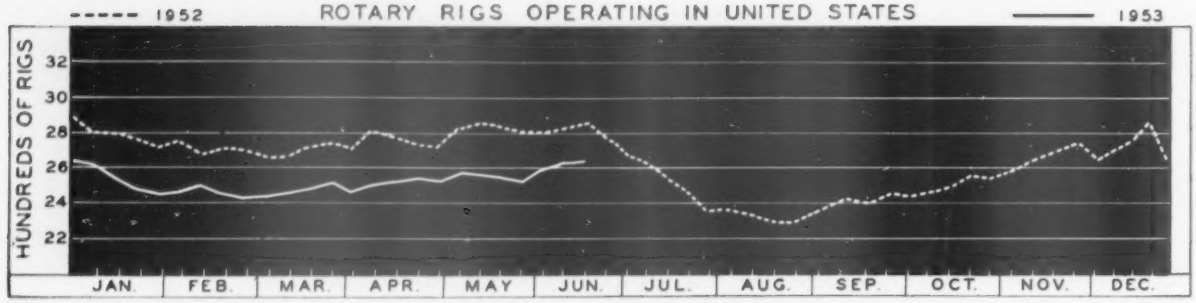
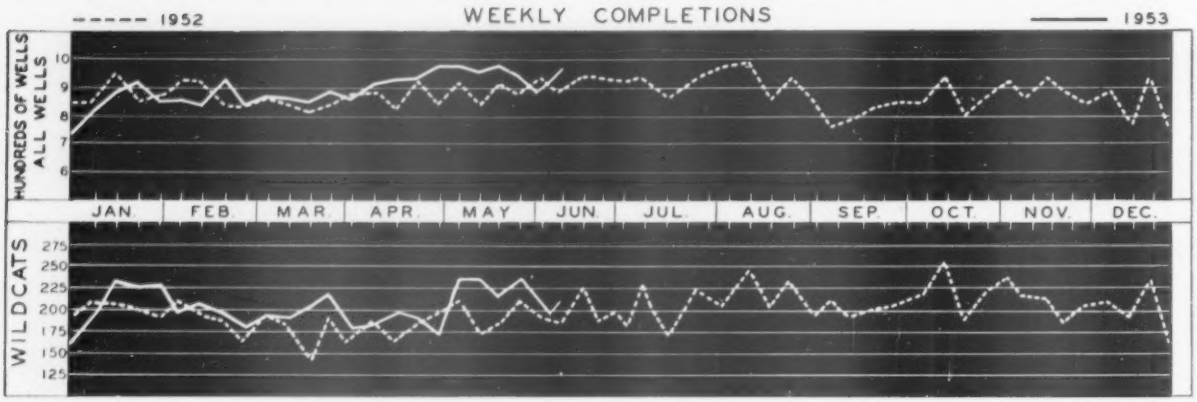




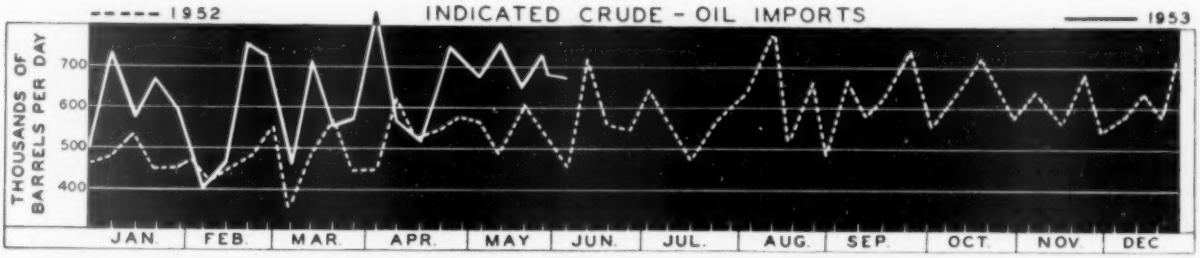
CURRENT STATISTICS

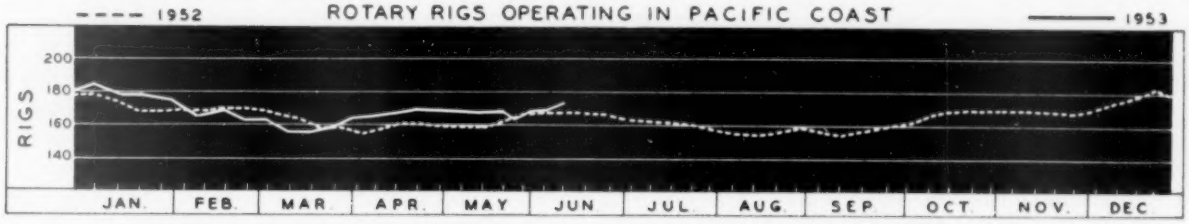
EXPLORATION

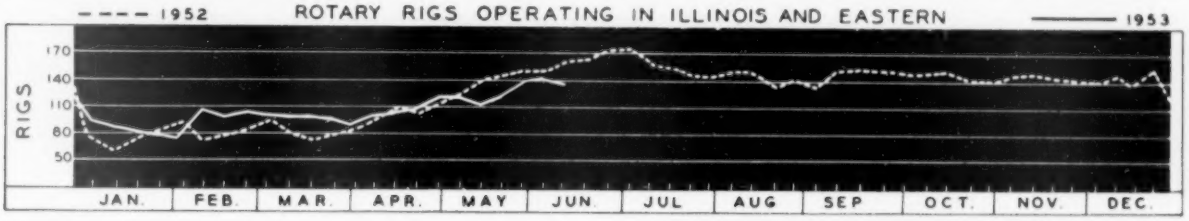
WEEKLY WELL COMPLETIONS . . . WEEK ENDED JUNE 13, 1953

	Total of all wells					June 13		Wildcat completions and discoveries					Cumulative total, 1953				
	Comp.	Oil	Gas	Dry	Footage	1953	1952	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	13	7	0	*6	19,200	306	354	0	0	0	0	0	0	0	0	0	0
Pennsylvania	33	16	4	†13	62,100	758	775	0	0	0	0	0	0	0	3	8	11
West Virginia	14	1	11	2	40,234	267	279	0	0	0	0	0	0	0	4	2	6
Ohio	13	5	1	27	26,967	440	444	0	0	0	0	0	1	0	1	10	12
Indiana	30	10	0	20	53,130	533	516	0	0	0	10	10	8	0	2	129	139
Kentucky	21	6	2	13	41,912	470	594	0	0	0	4	4	5	0	0	85	90
Illinois	44	19	0	25	106,076	772	731	0	0	0	11	11	3	0	0	157	160
Michigan	7	4	1	2	24,817	239	302	0	0	1	0	1	8	0	4	93	105
Kansas	90	37	6	47	312,227	2,205	2,100	1	0	0	23	25	51	0	19	348	418
Nebraska	8	3	1	4	39,069	136	103	1	0	0	3	4	11	0	1	60	72
Oklahoma	169	105	4	§60	535,513	3,181	2,654	1	0	0	14	15	52	4	13	284	353
Texas	346	199	19	128	1,603,639	7,689	8,326	19	1	1	75	96	391	28	91	1,870	2,380
North Central (Dist. 7-B & 9)	132	83	0	49	472,597	2,809	2,620	13	0	0	23	36	203	0	9	756	968
West (Dist. 7-C & 8)	64	47	0	17	320,411	1,677	2,611	0	0	0	12	12	76	2	6	294	378
Panhandle (Dist. 10)	15	4	6	5	54,385	368	304	0	0	0	2	2	0	2	0	14	16
Eastern (Dist. 5 & 6)	21	6	1	14	98,843	373	402	0	0	0	6	6	12	2	3	128	145
Gulf Coast (Dist. 2 & 3)	49	25	6	18	315,298	1,148	1,242	2	1	0	12	15	53	8	40	292	393
Southwest (Dist. 1 & 4)	65	34	6	25	342,105	1,314	1,147	4	0	1	20	25	47	14	33	386	480
Louisiana	52	30	4	18	364,871	1,115	1,023	1	3	0	7	11	28	12	11	151	202
Northern	22	8	3	11	93,964	440	538	1	0	0	5	6	2	1	2	55	60
Southern	30	22	1	7	270,907	675	485	0	3	0	2	5	26	11	9	96	142
Arkansas	6	2	0	4	20,633	197	170	0	0	0	3	3	5	0	0	38	43
Mississippi	8	1	1	6	51,010	158	169	0	0	0	2	2	8	0	3	75	86
Southeastern States	5	0	0	5	22,954	62	26	0	0	0	5	5	1	0	0	47	48
Montana	5	3	0	2	29,078	162	102	0	0	0	1	1	3	0	0	39	42
Wyoming	19	16	0	3	82,739	269	283	1	0	0	1	2	8	0	0	42	50
Colorado	18	6	2	10	93,549	239	179	1	0	1	7	9	10	0	8	115	133
Utah	1	0	0	1	6,008	34	30	0	0	0	1	1	2	0	0	22	24
New Mexico	15	11	1	3	108,142	583	457	0	0	0	1	1	8	0	6	55	69
California	52	42	0	10	262,476	1,159	1,145	2	0	0	10	12	26	0	3	263	292
North Dakota	6	5	0	1	50,657	112	18	0	0	0	0	0	3	0	0	20	23
Miscellaneous	0	0	0	0	0	21	38	0	0	0	0	0	1	0	0	17	18
Total United States	975	528	57	390	3,957,001	21,107	20,818	27	4	3	178	212	633	44	169	3,930	4,776
Total previous week	884	452	81	351	3,621,352			28	2	4	161	195	606	40	166	3,752	4,564
Total June 14, 1952	931	491	51	389	3,733,849			24	3	3	195	225	645	48	112	3,660	4,465

Service wells included: *6, †11, ‡1, §2.



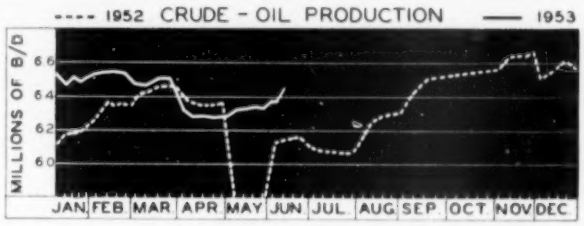


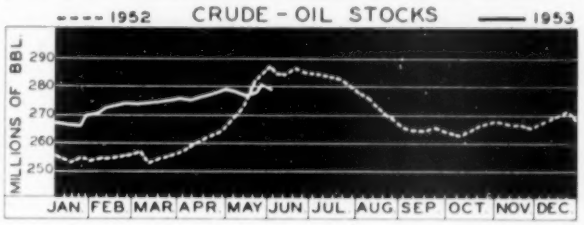


DAILY AVERAGE PRODUCTION FOR WEEK

	June 13 Crude oil	June 13 Lease condensate	June 13 Total	June 6 total
Alabama	5,100		5,100	5,000
Arkansas	76,650	650	77,300	77,450
California	1,015,500		1,015,500	1,002,800
Colorado	100,000		100,000	99,900
Eastern	58,800		58,800	58,600
Florida	1,450		1,450	1,450
Illinois	159,700		159,700	159,700
Indiana	35,700		35,700	35,800
Kansas	341,800		341,800	287,300
Kentucky	30,200		30,200	30,400
Louisiana	664,950	37,700	702,650	702,100
North	110,600	2,700	113,300	113,350
South	554,350	35,000	589,350	588,750
Michigan	34,400		34,400	32,800
Mississippi	94,400	4,250	98,650	98,350
Montana	30,400		30,400	30,400
Nebraska	13,900		13,900	14,000
New Mexico	195,075	950	196,025	195,000
Oklahoma	530,400		530,400	533,100
Texas	2,760,825	44,525	2,805,350	2,792,575
Dist. 1	36,300	400	36,700	36,500
Dist. 2	153,800	5,850	159,650	158,600
Dist. 3	447,175	22,700	469,875	468,650
Dist. 4	258,950	5,650	264,600	263,150
Dist. 5	48,750	350	49,100	48,800
Dist. 6	121,475	5,200	126,675	126,450
East Texas field	253,000		253,000	252,150
Dist. 7-B	115,900	50	115,950	114,800
Dist. 7-C	162,075	3,650	165,725	164,300
Dist. 8	910,800	200	911,000	907,800
Dist. 9	177,500	450	177,950	176,600
Dist. 10	75,100	25	75,125	74,775
Utah	5,400		5,400	5,200
Wyoming	210,900		210,900	210,900
North Dakota	14,700		14,700	14,700
Total U. S.	6,380,250	88,075	6,468,325	6,387,525
Change from previous week, up			80,800	
Canada	202,400		202,400	174,850
Total U. S. production January 1-June 13			1,053,483,975 bbl.	
Same period last year (crude plus cond.)			*1,007,008,650 bbl.	

*Includes 14,615,160 bbl. condensate.



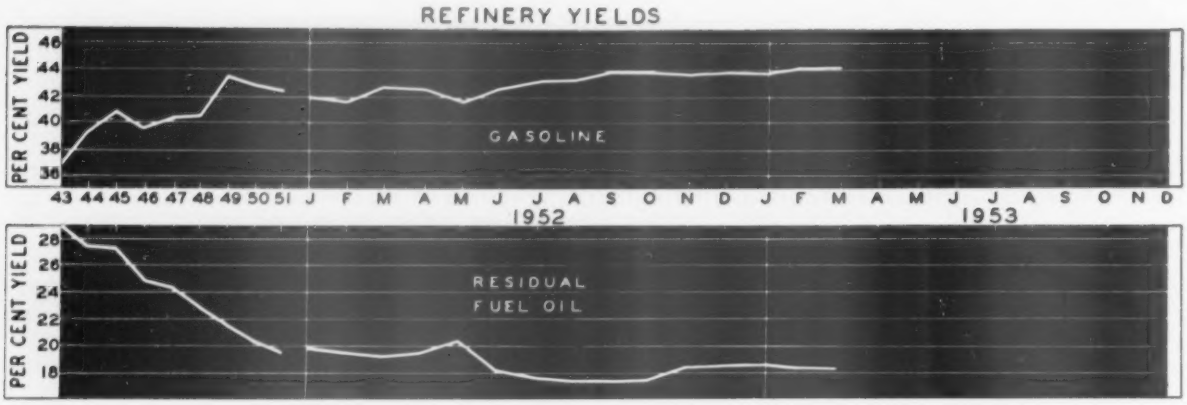


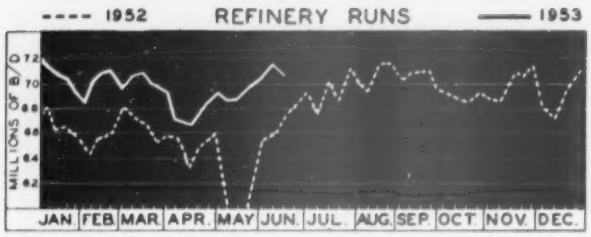
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

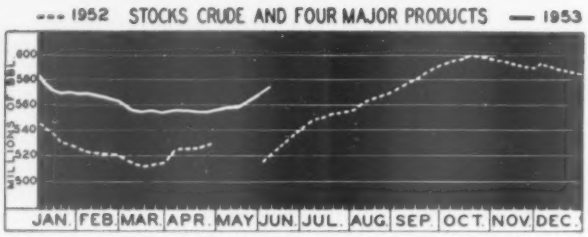
(Thousands of barrels)

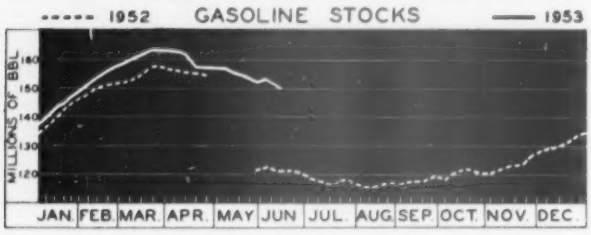
	June 6, '53	May 30, '53	June 7, '52
Pennsylvania Grade	2,631	2,543	2,519
Other Appalachian	2,236	2,231	1,993
Illinois, Indiana, Michigan	11,882	12,045	13,521
Arkansas	2,836	2,770	3,174
Louisiana	15,507	16,552	15,920
North	2,527	2,738	2,830
Gulf	12,980	13,814	13,090
Mississippi	4,007	3,801	3,422
New Mexico	7,131	7,215	7,729
Oklahoma and Kansas	39,566	39,533	43,023
Texas	131,047	132,852	140,374
East Texas proper	11,445	11,620	13,660
West Texas	61,643	62,616	60,188
Texas Gulf	25,978	25,628	32,405
Other Texas	31,981	32,988	34,121
Rocky Mountain	17,905	18,169	15,374
California	32,841	32,689	30,498
Foreign	†10,318	10,281	7,389
Total	277,907	280,681	284,936

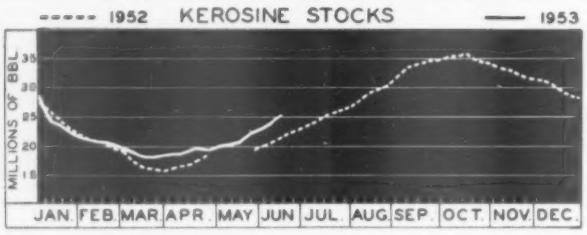
*Bureau of Mines. †Includes 2,226,000 bbl. in California.

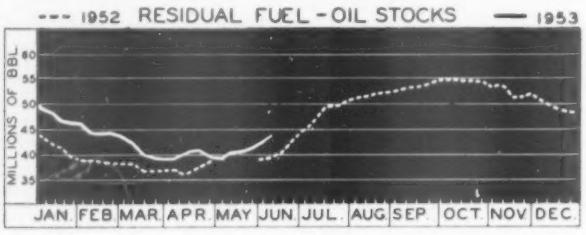










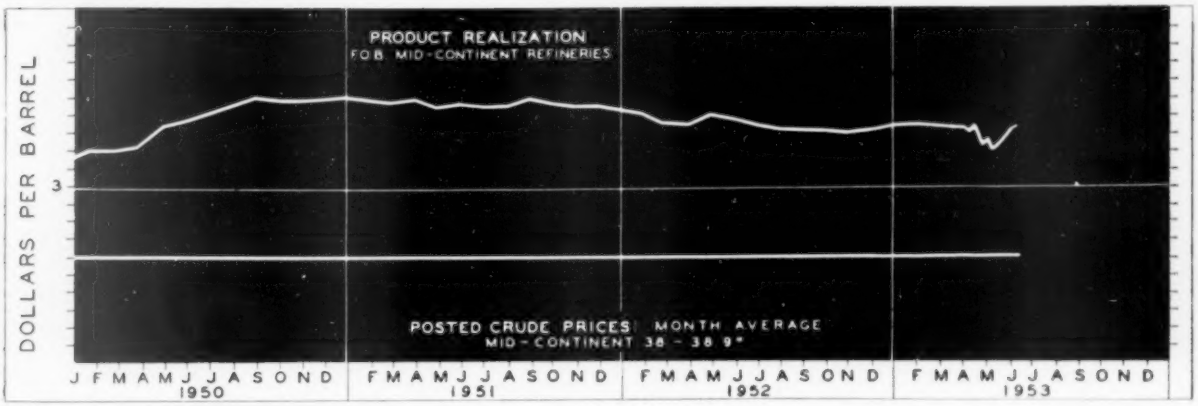


A.P.I. REFINERY REPORT, JUNE 13

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, June 1952—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,069	449.7	38.2	235.4	240.4	34,502	10,992	26,101	11,800	1,125	419.0	35.7	256.1	240.1
Appalachian:														
District 1	106	45.0	6.1	15.7	15.0	3,504	502	891	460	110	48.0	4.6	14.5	13.2
District 2	84	42.6	6.3	9.6	8.8	1,590	312	425	157	77	38.4	2.0	12.9	12.3
Ind., Ill., Ky.	1,245	657.9	74.2	211.0	156.6	30,204	4,724	11,766	3,272	1,240	659.8	67.5	230.8	156.4
Okla., Kans., Mo.	619	334.4	19.4	142.7	57.3	15,904	1,520	8,672	1,255	540	294.9	15.6	126.6	51.8
Inland Texas	255	160.6	13.7	51.6	34.1	6,185	470	1,492	1,163	271	171.9	11.1	44.8	41.2
Texas Gulf Coast	1,723	839.9	128.3	374.7	254.0	20,624	3,554	11,412	6,644	1,603	717.6	118.0	418.9	259.5
La. Gulf Coast	571	292.7	53.4	153.0	50.6	7,771	2,278	5,529	1,368	538	236.8	45.3	132.3	52.8
N. La. and Ark.	85	30.1	8.4	23.0	7.6	3,124	410	985	165	85	32.8	6.5	19.4	5.8
Rocky Mountain:														
New Mexico	20	12.1		2.9	3.9	190		34	32	18	10.9	.3	2.9	4.2
Other Rocky Mtn.	240	119.0	3.1	54.7	41.3	6,657	260	1,934	975	235	110.8	6.3	45.1	40.9
California	1,009	474.6	1.0	152.3	359.7	20,502	420	10,338	16,304	983	428.3	4.4	150.4	349.4
June 13, 1953	7,026	3,458.6	352.1	1,426.6	1,229.3	150,757	25,442	79,579	43,595	6,825	3,169.2	317.3	1,454.7	1,227.6
June 6, 1953	7,168	3,451.0	301.3	1,588.1	1,187.4	152,592	24,234	76,811	42,453					
June 14, 1952	6,762	3,114.6	315.4	1,471.1	1,288.1	121,993	21,086	57,944	40,889					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipe lines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
3
POSTED CRUDE PRICES: MONTH AVERAGE
MID-CONTINENT 38 - 38 9°
J F M A M J J A S O N D
1950
F M A M J J A S O N D
1951
F M A M J J A S O N D
1952
F M A M J J A S O N D
1953

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.35 for week ended June 6, $3.31 for previous week, and $3.39 for June 1952. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of June 17, 1953. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	10⅜-10½	12.5-13	10¾-11
Premium gasoline	11⅜-12	13.5-14.25	11¾-12
42-44 w.w. kerosine	8⅜-8¾	10-10.65	9
No. 2 straw fuel oil	7⅜-7¾	9-9.65	8
No. 6 residual	$0.95-1.05	$2.10-2.25	$1.60-1.70

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5½	5	5¼
Grade 18-55	6.60	6.10	6.35

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	12
750 vis., No. 3-4 neutral	15
2,000 No. 5-6 neutral	17

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	19.5-20.5
200 vis., No. 3 neutral, 0-10 pp.	13

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	25.5
180 vis., 10 p.t. neutral	27.5

WAX

Mid-Continent

132-134 A.M.P.	6.0

REFINERS in most areas of the country have been studying all possible revisions in petroleum product prices that can come from the general increase of $.25 a barrel in crude prices.

In the period before the war when much of the increase in demand for petroleum products was due to larger gasoline demands, motor fuel had to bear most of the load caused by an increase in the price of crude.

Since the latest crude-price increase came near the beginning of the gasoline season, many marketers are predicting that gasoline price increases again will have to cover a large part of the direct increase in crude costs. Since the heavy-fuel market, particularly in the Mid-Continent and North Central areas, is abnormally firm for this time of the year, No. 6 prices may move up at least 10 cents a barrel.

Gasoline yields at Mid-Continent refineries average a little better than 50 per cent or a little more than 21 gal. from a barrel of crude. If the refiner can get a cent a gallon more for his gasoline, he can recover 21 cents of the increased crude cost.

For the integrated company, the first announced price raises are at the tank-wagon level. The new prices at this level will in turn be reflected in higher posted tank-car prices and higher prices to jobbers marketing branded gasolines. Some marketers in the Mid-Continent believe that it will take more time for the new price structure to penetrate the actual spot market. For this reason, the range between the "high" and the "low" of gasoline quotations will be much greater than normal.

Since distillate markets were soft even at the old prices, home-heating fuels probably will not be able to carry any of the increased refinery cost until the rush to fill storage just before the heating season. Distillate should carry its share in the winter.

CRUDE PRICES
GRAVITY SCHEDULE

	Signal Hill, Calif.*	Oklahoma, Kansas	Gulf Coast Tex.†	West Tex.‡
14-14.9	$1.87			
15-15.9	1.93			
16-16.9	1.99			
17-17.9	2.05			
18-18.9	2.11			
19-19.9	2.18			
20-20.9	2.24	$2.50		$2.37
21-21.9	2.30	2.52		2.39
22-22.9	2.37	2.54		2.41
23-23.9	2.45	2.56		2.43
24-24.9	2.53	2.58	$2.91	2.45
25-25.9	2.61	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9		2.76	3.09	2.63
34-34.9		2.78	3.11	2.65
35-35.9		2.80	3.13	2.67
36-36.9		2.82	3.15	2.69
37-37.9		2.84	3.17	2.71
38-38.9		2.86	3.19	2.73
39-39.9		2.88	3.21	2.75
40 and above		2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast. ‡Includes New Mexico Permian.

Prices after increase effective June 15, 1953. General increase was $0.25 but some Gulf Coast crudes were up $0.35.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Pecos County (Yates)	2.57
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	4.40
Southwest Pennsylvania	3.97
West Virginia	3.91
Illinois Basin	3.02

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EVERYTHING in new and used equipment for well drilling. Fishing tools rented. Save money, get quotations from Pressey & Son, Pueblo, Colorado.

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SUPERIOR HEAVY DUTY DIESEL

510 hp. at 360 r.p.m.—5 cylinder—14½x18 type ZDSB — non-reversing — vertical—4 cycle—cold starting—mechanical injection. Engine is totally enclosed. Complete with a 48" 7 groove V-belt sheave and new spare parts. For heavy duty pumping, dredge service, power generation, textile and saw mills, mining, etc. EXCELLENT CONDITION, IMMEDIATE DELIVERY.

G. M. 3-71 DIESEL GEN. SET

30 kw. 2 cylinder 4½x5 diesel—radiator cooled—electric starting. Delco 3/60/440 generator — with switchgear. Skid mounted. Portable.

30 KW SHEPPARD DIESEL SETS

30 kw. Sheppard—115 volts DC—radiator cooled . Built 1950. Excellent condition. Self-mounted radiator and fuel tank. 16 units available.

75 KW WAUKESHA DIESEL GENERATOR SET

75 kw.—230 volts DC—totally enclosed, self-contained. Waukesha 6 cyl., 160 hp., 1200 r.p.m. diesel driving 75 kw. 1200 r.p.m. G. M. marine type generator. Self-contained switchboard and radiator.

100 KW G. M. 3-268A A.C. DIESEL GENERATOR SETS

440 volts—3 phase—60 cycle. 20 kw. D.C. generator on same shaft—5 kw. exciter —120 volts D.C.—electric starting.

LORIMER SLOW SPEED 100 KW A.C. DIESEL GENERATOR SET

Slow speed heavy duty unit. 150 hp.—5 cyl.—4 cycle—720 r.p.m.—electric starting—Ross heat exchanger—engine operating panel. Allis-Chalmers generator—100 kw.—440/3/60—80% PF—cubicle deadfront switchgear. Can quote with radiator if desired.

300 KW G. M. D.C. DIESEL SET

ENGINE: G.M. 8-268A—6½x7—1200 r.p.m. —air starting. GENERATOR: 300 kw. G.E.—120/240 volts D.C.—3 wire—totally enclosed—Marine type BB—with switchgear.

ELECTRIC WINCHES

Single drum—50 hp. 230 volt D.C. motors —built-in controls.

STEAM TURBO-GENERATOR SETS

300 kw—120/240 volts D.C.—1200 r.p.m. —1250 amps.—turbine W.P., 225 lbs. to 440 lbs.

MARINE SURFACE CONDENSERS

1050 sq. ft.—3000 sq. ft.

THE BOSTON METALS CO.
313 E. BALTIMORE ST.
BALTIMORE 2, MARYLAND
CURTIS 7-5050

EQUIPMENT FOR SALE

DRILLING EQUIPMENT FOR SALE: Mud pumps, swivels, travelling blocks. This equipment is brand new and produced by a reliable manufacturer, and is offered for sale at reduced prices. Box G-523, The Oil and Gas Journal, Tulsa, Oklahoma.

TWO — 60W — BREWSTER — 6000'— Well-Servicing Units, Complete, W/Rod & Tubing Tools. 8 x 7 Double Pole Mast, Truck Mounted, Ready to Work. Also, Allis-Chalmers, Muskogee, Wilson & Cardwell Skid Units. General Tool & Supply Co. P.O. Box 4387. Oklahoma City, Okla.

FOR SALE

New and Used material—Immediate delivery from stock, Angles, Channels, I and WF Beams, especially for construction needs.

H BEAMS **PILE SECTIONS**

Phone or Wire your steel requirements.

We are also interested in purchasing your surplus material. We assure you our prices will be the best obtainable.

CARSAND STEEL CORP.
14-23 34th Avenue
Astoria, New York
Astoria 8-4484 8-8023

EQUIPMENT FOR SALE

NEW LEE C. MOORE 100' Cantilever Mast for sale. 18' x 40' 9" base. 510,000#. Herman Graham Drilling Co., Salem, Ill.

USED ROTARY, cable tools, and production equipment. E. A. Kelly, 3131 S.E. 29th Street, P. O. Box 861, Oklahoma City. Phone Jackson 56407.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units.

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

FOR SALE
DIESELS AND PUMPS

Two new 1947 unused 475 BHP 5 cylinder Baldwin Model VG Diesel Engines, each connected to Worthington Horizontal Triplex Double Acting Pump, both units with Falk Couplings and other accessories. Location Ohio, immediate delivery. Direct inquiries to

THE BUCKEYE PIPE LINE CO.
Joseph Steele, Purchasing Agent
Room 2200, 30 Broad St.
New York 4, N. Y.

FOR SALE
COMPLETE ROTARY DRILLING RIG

1—Wilson Super Titan Draw Works—Complete with Foster Spinning Cathead—Foster Breakout Head—Double Hydraulic Brakes—Four Engine Compound—Air Control operated with Westinghouse Compressor.

4—Cummins 600 Disel Engines with Substructures.

1—136' Lee C. Moore Derrick with substructures.

1—8" x 20" Gardner Denver Power Pump complete.

1—7¼" x 18" Wilson Snyder Power Pump complete.

2—Cameron 900 Series 10" Blowout Preventors.

15—4" x 30" Drill Collars.

Approx. 13,000 feet of 4½" OD 16.60 lb. Grade "E" Extra Hole Drill Pipe—Flashweld Joints.

Mud Tanks—Fuel Tanks—Circulating Tanks. All necessary tools and pipe for operating rig.

This equipment in first-class condition ready to move on well and start drilling.

FOR COMPLETE INVENTORY—CALL—WIRE—WRITE

BROWN PIPE & MACHINERY COMPANY
FOrtune 7431 **1311 W. T. WAGGONER BLDG.**
FORT WORTH, TEXAS

EQUIPMENT FOR SALE

FOR SALE: Several hundred Domestic Gas meters and spring-type regulators. Also several hundred one-inch brass service cocks, good as new. Laughner Oil & Gas Company, 1010 Merchant Street, Ambridge, Pa.

FOR SALE: 1 Wilson Atlas Draw Works, Serial #6245. 2 G.A.K. Waukesha engines, completely overhauled with all new parts. A-1 condition. Makin Drilling Company, Box No. 1628, Phone 3-3141, Hobbs, New Mexico.

N-4 BREWSTER rotary drilling rig, 12" Gardner-Denver pump w/ NKU Waukesha engine, Lee C. Moore mast, 5½' Substructure, 5800' of 3½" Ext. upset int. flush drill pipe. All purchased new. Has been in use 12 mos. A-1 condition. Write Box 4657, Oklahoma City, or Pho. ME 4-1413.

JOY 300 Drilling Rig butane powered, mounted on Brockaway 6x6 truck, 3500 feet 3½ inch drill pipe. Auxiliary mud pump and butane engine as separate unit. All tools and equipment included. This rig in first-class working condition and ready to go to work immediately. Call or write Steele Brothers, Crete, Nebraska. Phone 127.

3—100 KVA 6900/460/230/115 volt 60 cy. Westinghouse Type SK Style #488595 oil transformers—standard accessories. Condition A-1, electrically like new. $699.00 each FOB K.C., Mo. Brundred Oil Corp., 208 Nichols Rd., Kansas City, Mo.—Westport 1866.

FOR SALE

4500' 4" standard, 2500' 4½" standard, 9200' 6" standard, in single and double random lengths, plain end, all straight, clean, shows no pitting, located Rawlins, Wyoming.

10,000' 4¾" O.D. used seamless steel tubing, ⅜" wall, approx. 28' lengths, plain end, located near Chicago.

We carry large quantities of used seamless steel boiler tubing from 1⅜" O.D. to 5½" O.D. suitable for high pressure oil, gas and water lines, all straightened, cleaned inside and out, shows practically no pitting, all tested for 1000# hydrostatic pressure at our plant before shipment.

Also large quantities of new and guaranteed used steel pipe and tubing up to 36" in diameter in lightweight, standard and extra strong.

All for immediate shipment. Please phone or wire collect.

A. GREENSPON PIPE CO., INC.
50 South Bemiston Avenue
St. Louis 5, Missouri
Phone: PArkview 6885

FOR SALE

FOREIGN A.P.I. PIPE

Immediate delivery from Houston stock

J-55 Grade, Moody inspected, 5½" x 15½ lbs., Range 2 LT and C.

WRITE—WIRE—PHONE

Standard International Corp.

120 Wall Street **New York 5, N. Y.**

Tel.: WHitehall 3-1600

EQUIPMENT FOR SALE

WE OFFER: Two casing pulling units—Hydraulic operated—in A-1 condition—together with two pickup trucks 1950 and 1952 models and two heavy metal tool houses and one circulating unit. Pipe Pulling, Inc., Stafford, Kansas.

USED 4½" and 3½" Sonoscoped Drill Pipe, Casing, Tubing, Rotary and Cable Tool Rigs and production equipment. Giffin & Thompson Supply, Hoisington, Kansas. Tel. 477.

FOR TRADE: Cardwell Oil Well Service Unit complete. What have you? J. L. Chew, Lyons, Kansas.

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

D-13000 and D-17000 Caterpillar engines skid mounted for driving piston pumps or centrifugal pumps. Located in southern Illinois. Priced for fast sale. Sohio Pipe Line Company, 407 N. 8th St., St. Louis, Mo.

FOR SALE: 13 Gas Compressors, Bessemer Type 8, 70 and 80 Horsepower; 2 Pumps, Vertical Triplex, 7" x 10", Belt Driven (Less Drivers); 3 Pumps, Goulds Centrifugal, 1 Size 5L and 2 Size 3 DL (Less Drivers). Also available 3 Partially Dismantled Bessemer Type 8 Gas Compressors and 3 Wood Frame Corrugated Iron Buildings, 1—30' x 109' x 14' and 2—30' x 60' x 14'. All Items Secondhand. Located near Electra, Texas. For details, write P.O. Box 1720 or Telephone FAnnin 5231, Fort Worth, Texas.

FOR SALE: 60,000 4½ o.d. s.s. line, 60,000 3½ o.d. line all new. 5—55,000 bbl. tanks. 5—10,000 and 5—5,000 tanks. Lundquist Pipe & Supply Co. Phone 5-8850, Tulsa, Okla. P. O. Box 1215.

FOR SALE: 5—Shriver 42"x42" cast iron Filter Presses, Plate & Frame Type, 27, and 54 chambers 1" cake; 15—Sperry 18"x18" cast iron Filter Presses, 11 chambers; #12 Sweetland Filter for 72 monel covered leaves on 2" centers. Immediate shipment. Attractively priced. Consolidated Products Co., Inc., 17-20 Park Row, New York 38, N. Y. BArclay 7-0600.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

FOR SALE

Complete National 100 Rig including 3 PTD-6 Superior Diesel Engines with dual fuel equipment, 136' Lee C. Moore Mast with 8' substructure, 2 C-350 Ideal Power Pumps, Ideal Type 548 TC Traveling Block, Type R3 Swivel, and Type MS-20½ Rotary Table. Excellent condition, priced reasonable, located in Montana. Complete inventory upon request.

Box G-341

The Oil and Gas Journal,
Tulsa, Oklahoma

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TUBING
CASING
LINE PIPE

Buy **NOW**
to fill in domestic shortage.
Early shipment direct from mills
in Germany - Japan
A.P.I. Specifications
Mill Agents

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EQUIPMENT WANTED

WANTED: Three used 12 cylinder RXIVW LeRoi engines, in good condition, at a bargain. Makin Drilling Company, P.O. Box 1628, Hobbs, New Mexico. Phone 3-3141.

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

NOTICE: We buy, We sell equipment everywhere. If you want to sell or buy, contact Pressey & Son, Pueblo, Colorado.

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale? Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

WANTED—Bolted type steel tanks, new, and if used must be A.P.I. late type having a capacity of 500 bbl. and larger. Also high pressure welded steel tanks 10,000 gal. and larger for propane.

A. GREENSPON PIPE CO., INC., 50 South Bemiston Avenue, St. Louis 5, Missouri. Phone: PArkview 6885.

HELP WANTED

WANTED: Experienced Safety Engineer, for oilwell drilling contractor, with nine (9) rotary rigs operating in West Texas and Southeast New Mexico area. In applying, give age, references, and experience. Reply Box G-496, The Oil and Gas Journal, Tulsa, Oklahoma.

SALES ENGINEER: Familiar with design and sale of gas process equipment—gasoline plants. Box G-549, The Oil and Gas Journal, Tulsa, Oklahoma.

MANAGER

Engineering Research

Major petroleum company's centralized Engineering & Construction Department, which renders all phases of engineering service to every department in the company, has an unusual opportunity for a man to manage the Engineering Research Division. We are looking for a graduate engineer with an impressive record of accomplishment in engineering methods, standards, and testing. Must be thoroughly familiar with electrical, mechanical and metallurgical aspects of process equipment and construction materials. For further details, send a brief statement of your training and experience in strict confidence to H. M. Overley,

The Atlantic Refining Co.
P.O. BOX 7258
PHILA., 1, PA.

WANTED

PRODUCTION SUPERINTENDENT
CHIEF PETROLEUM ENGINEER
EQUIPMENT ENGINEER
RESERVOIR ENGINEER
DRILLING ENGINEER
PRODUCTION FOREMAN
GASOLINE PROCESS ENGINEER
ASSISTANT CHIEF GEOLOGIST
SURFACE GEOLOGIST
SUBSURFACE GEOLOGIST
EXPLOITATION GEOLOGIST

For work on DeMares Concession, Colombia, South America. Excellent salary plus substantial income tax savings. Good living conditions. Two year contract. Annual local vacation and paid vacation to United States if contract renewed. Give details of age, education and experience by letter. All replies held confidential. Reply to Box G-516, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

OIL Industry Employment Service, 405 Tuloma Bldg., Tulsa, Okla. 4-5974. Tom Robinson, owner. For Technical and Trained Personnel, including LPG.

ELECTRICAL ENGINEER: Must be a graduate EE under 32 years of age with 3 to 5 years supervisory experience in industrial plant electrical maintenance. Location Central Illinois. New multi-million dollar plant. Salary open. Write giving complete details of education, experience and salary expected to Personnel Manager, National Petro-Chemical Corporation, Box 109, Tuscola, Illinois.

MANUFACTURER'S AGENT
to represent manufacturer of oil-field drilling equipment in the Louisiana-Mississippi territory. Write Box G-547, The Oil and Gas Journal, Tulsa, Oklahoma.

MANUFACTURER'S AGENT
to represent manufacturer of oil-field drilling equipment in the West Texas territory. Write Box G-548, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEERS

FOREIGN SERVICE

Graduate engineers with good background in general physics, mathematics, mechanics and with some laboratory experience in equipment and techniques. For laboratory position responsible for theoretical experimental studies on reservoir fluid and rocks. Duties will consist of designing equipment, performing or supervising testing and analyzing and reporting results. Studies pertinent to evaluation of primary depletion practices and applicability of secondary recovery for pressure maintenance operation will be required.

Please write giving full particulars regarding personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR
BOX OG-5
Arabian-American Oil Company
505 Park Avenue
New York 22, N. Y.

WANTED

CHIEF GEOLOGIST

for

Aggressive Independent Oil Company

Operating in Rocky Mountain Area, Mid-Continent, North and West Texas.
Experience in these areas desirable. Give complete details of education and experience by letter in duplicate. All replies held confidential.

Box G-460
THE OIL AND GAS JOURNAL
Tulsa, Oklahoma

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co Box 2603, Tulsa, Okla. $5.00 cash.

DESIGN ENGINEER: Mechanical Design Engineer with 5 to 8 years experience in design of drilling equipment — specifically draw works, rotary tables, and masts. Progressive expanding company, excellent working conditions and benefits. Salary commensurate with experience. REYNOLDS METALS COMPANY, 2000 S. Ninth Street, Louisville, Kentucky.

CONTINENTAL Oil Company has several openings for Petroleum Production Engineers in the Rocky Mountain Region. Minimum 3 years' experience required. Also have opening for Mechanical Engineer with oil field experience. Apply to C. C. Frye, Regional Petroleum Engineer, Denver, Colorado.

REFINERY Engineer for small independent company, 30-40 years of age, Project Estimating, Design, Drafting. Give detailed experience and salary expected. Box G-536, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION SUPERINTENDENT — Independent oil company has opening around July 1st for experienced production man familiar with all phases of development and lease operations in Mid-Continent Area—Age 30 to 45. In replying, furnish past ten-year employment record. Box G-522, The Oil and Gas Journal, Tulsa, Oklahoma.

SALES MANAGER wanted for drilling equipment. Applicants should have field experience. Knowledge of diesel engines desirable. Apply stating age, experience, and salary required to personnel manager. Box G-539, The Oil and Gas Journal, Tulsa, Oklahoma.

PROCESS ENGINEERS

Engineering contractor has openings which offer excellent opportunities for young Process Engineers with background in chemical, refining, or gas & gasoline industries, for permanent position in office located in Tulsa, Oklahoma. One to five years experience is desirable but college education & willingness to assume responsibility are essential. Applicants should write giving age, resume of experience, education and salary expected. Please address Box G-519, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICAL PERSONNEL

Party Chiefs, Computers, Operators, Shooters, Surveyors, wanted by major oil company starting its own geophysical organization.

Write giving personal, educational and experience qualifications, and references. All replies confidential.

Box G-540
THE OIL AND GAS JOURNAL
Tulsa, Oklahoma

CHIEF DEVELOPMENT ENGINEER

Assume responsibility for extensive development program covering oil and gas processing equipment currently involving twelve engineers. Proven ability to supervise technical employees and programs of a high order essential. Long range, well paying position with nationally known, medium sized corporation. Southwest location.

Box G-546
The Oil and Gas Journal
Tulsa, Oklahoma

HELP WANTED

A FIRST-CLASS Instrument Man capable of servicing the latest type of instruments on Catalytic Cracking and general refinery processes. Give complete brief of experience and personal data in letter. Delta Refining Company, located at Memphis, Tenn.

THE POSITION YOU WANT: Oil industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

SITUATIONS WANTED

OFFICE MANAGER, Controller, Executive Assistant desires responsible supervisory position with growing oil company. Rocky Mountain Area preferred. Presently employed by oil refinery on West Coast. Six years extensive experience with emphasis on public and personnel relations with this company. Accounting background. Age 31. Married. Box G-532, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 1628, Ph. No. 3-3141, Hobbs, New Mexico.

PETROLEUM Engineer, 36, married. Desires position with major or active independent. Twelve years experience. Production problems; well completions; reconditioning and recompletion recommendations; gas lift; water flood; reservoir studies. Excellent references. Available immediately. Mid-Continent or Rocky Mountains preferred. Box G-530, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER, twelve years in refining and petrochemicals is interested in manufacturer's representationship or private venture in Corpus Christi area. Box G-544, The Oil and Gas Journal, Tulsa, Oklahoma.

CORROSION ENGINEER wants promotion. More than ten years experience with major company in Corrosion Control on bare and coated pipe lines. Registered Engineer. Supervisory experience. Capable of organizing and directing a program of Corrosion Control. Box G-543, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST—Independently operative in Central and Eastern Oklahoma. Has up-to-date subsurface structural mapping system and records available for checking merit of leased acreage and recommendation of preferred locations for oil exploration. Salary or retainer. Post Office Box 1884, Tulsa.

CHEMICAL ENGINEER—6 years supervision in distillery plant maintenance and production. 1½ years process and operation—low temperature air fractionation. Age 32. Box G-542, The Oil and Gas Journal, Tulsa, Oklahoma.

LANDMAN with three and one-half years experience with major company in West Texas desires position on Texas-Louisiana Gulf Coast. Familiar with lease purchasing, title curing, farmouts, office work, etc. Box G-550, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST 8 years experience in oil exploration including interpretation, administration, and geological coordination work. Presently employed directing varied geophysical program in South America. Desires responsible position in oil exploration work in eastern USA. Box G-511, The Oil and Gas Journal, Tulsa, Oklahoma.

Young Executive, thirteen years diversified experience in the Petroleum Industry, with completely integrated independent companies as Chief Accountant, Office Manager, District Manager, and General Manager. Thoroughly familiar with Finance and Organization. Will be available after July 1. Desires a position with a future. Not afraid of work or responsibilities. Box G-535, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

GEOLOGIST with 30 years experience in oil exploration plans change. Now executive with major company. Excellent record, including the discovery of substantial oil and gas reserves at moderate cost. Interested in new connection based on salary combined with either stock option or other incentive plan. Replies invited from principals only. Write Box G-521, The Oil and Gas Journal, Tulsa, Oklahoma.

C. P. A. Age 36, heavy public and administrative accounting experience. Experienced in oil and gas accounting and taxation. Desire association with independent operator or small oil company in Houston, Texas. Box G-533, The Oil and Gas Journal, Tulsa, Oklahoma.

LANDMAN, five years land and title experience; LLB and BBA degrees; 34 years of age; references furnished. Box G-508, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED SEISMOLOGIST and Party Chief with 6 years seismograph experience in U. S. and Foreign desires position as interpreter or seismologist with oil company. Location open. Box G-553, The Oil and Gas Journal, Tulsa, Okla.

DRILLING - PRODUCTION ENGINEER, 26, married. Five years varied experience. Capable of handling drilling-completion program, workover recommendations and related production problems. Presently employed by major as field engineer. Desire active independent. Position must offer responsibility and opportunity. Box G-551, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column? Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

RESORTS

MOUNTAIN GUEST RANCH

Crossbow Ranch in Beartooth wilderness area east of Yellowstone Park may be reserved for your private use. Modern cabins, meals, horses and complete staff provided to insure your comfort and pleasure. Excellent trout fishing in streams and lakes, riding, cool mountain air. Ranch Office: Box 1696, Billings, Montana. Phone 9-7553.

RANCHES

COOL SKY-COUNTRY RANCH: Beautiful ranch, 8,000 ft. high in mountains 38 miles west of Trinidad, Colorado. Perfect for corporation's executive and key employee vacations and customer entertainment. In Las Animas County, adjacent to Monument Lake. Beautiful guest house completely furnished down to linens and deep freeze. All utilities, central heat. Living room 22 x 35 with open fireplace, maple ranch furniture. 2 spacious master bedrooms, each with bath, one with king-size bed, other with 2 double beds. Lovely veranda overlooking Spanish Peaks. Also, foreman's 3-room, 1-bath house. Property completely set up for cattle operation, 5 and 6-wire fence and mile of rail fence, gates, loading chutes, box stalls for horses, etc. About half in improved meadows, all 567 acres grazable. Water rights on three water courses through property. Choice hunting, fishing, plenty trout, deer, other game on place. Has everything for executive use, ready to move in, will consider oil payment from proven properties. Morgan McCall, P.O. Box 748, Ph. 3-3442, Baton Rouge, Louisiana.

PRODUCTION WANTED

WANT to buy production in Texas or Oklahoma. Box G-527, The Oil and Gas Journal, Tulsa, Oklahoma.

WANT TO BUY

From Principal Owners Only
At Least 1,000 Bbls. Per Day of
Settled Production
Cash Deal Preferred

Box G-531, The Oil and Gas Journal, Tulsa, Oklahoma

ROYALTIES

PRINCIPAL will buy $100,000.00 to $200,000.00 worth of oil (or gas) royalties that are developed. Will purchase direct from owners or through authorized broker. Prefer a group of interests in several areas. Send 1952 and 1953 income by months. Box G-552, The Oil and Gas Journal, Tulsa, Oklahoma.

IN ELK CITY FIELD, offering royalties ahead of the drill, conditional guarantee with sale, contact owner: A. S. Berry, P. O. Box 1383, Tulsa, Okla.

PRODUCING ROYALTY and overrides for sale. Wire-write-call for particulars. JACK EAGLE, 706 City Natl. Bldg., Okla. City, Okla. REgent 6-7027.

QUICK CASH: Producing royalties, Overrides or Production . . . no delay. Phone 72-4533, Robert L. Kinkaid . . . P.O. Box 26, Tulsa, Oklahoma.

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column use a Journal classified advertisement to find it. See box heading for classified rates or write The Oil and Gas Journal.

WE WILL BUY

Producing royalties overriding royalties and production, any amount. Submit complete detail information. Confidential.

COMBEST ROYALTY COMPANY
Amarillo Building, Amarillo, Texas

ROYALTIES WANTED
Producing Royalties
High Grade Only
Send Full Particulars
Address

C. C. HARMON
719 World Bldg., Tulsa, Okla.
P.O. Box 2151

LEASE AND DRILLING BLOCKS

SEE A. L. Bowles, Rollow Building, Ada, Oklahoma, for drilling deals.

FOR LEASE ½ Oil and Gas 25 acres ½ mile to good well. Timbered Land $1250.00 or 1 year $350.00 per location for timber. F. M. Falley, Louisville, Illinois.

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

CENTRAL KANSAS drilling deals, will farm out or sell interest and drill myself, 1,000 to 4,000 feet. Lewis Short, Burrton, Kansas.

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

LEASES ROYALTIES

Producing and Nonproducing

Bought and Sold—Any Area

Inquiries Invited

B. D. BUCKLEY

6635 Delmar Ave., St. Louis 5, Mo.

REAL ESTATE

155 ACRES on promising structure producing oil and gas wells within ½ mile on north and west new wells being drilled on north. John Harlow, Louisburg, Kansas.

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal.

ELECTRICAL CONTRACTORS

Office Phone	Res. Phone
5-5315	7-4950

W. L. RATCLIFF COMPANY
ELECTRICAL CONTRACTORS
Industrial—Commercial—Distribution

W. L. Ratcliff	506 Caddo St.
P. O. Box 373	Shreveport, La.

Cardwell Mfg. Changes New York Office Location

Cardwell Manufacturing Co., Inc., changed the location of its New York office on May 1. Present address is 277 Park Avenue, New York.

W. E. Volkman, assistant export manager, is in charge of the New York office.

Greenland, Bixby Named District Sales Managers

J. Allan Greenland has been named sales manager of the San Francisco district office of De Laval Turbine Pacific Co., and Donald T. Bixby as sales manager of the Seattle district office, it was announced recently by W. A. Neumann, Jr., vice president in charge of sales for De Laval Steam Turbine Co., Trenton, N. J. De Laval Turbine Pacific Co. is a wholly owned De Laval subsidiary with main offices and plant in San Francisco and district offices in Los Angeles and Seattle.

Greenland joined De Laval in 1938 as a test engineer at the Trenton plant, and served in various engineering and sales capacities until transferred to the Seattle office as sales engineer. He was appointed sales manager of the Seattle district office in 1948.

Bixby came to De Laval in 1945 as a sales trainee and served in a sales engineering capacity in the Standard Products Division until transferred to San Francisco in 1951.

Welex Jet Services, Inc. Expands Oklahoma Services

Welex Jet Services, Inc., has announced the opening of a new district field station at Stillwater, Okla., with J. P. Pouland as district manager. The addition of Stillwater to the present established districts at Ardmore, Shawnee, and Pauls Valley, brings the number of Welex field stations to four in the Oklahoma division.

Also announced by the company is the addition of gamma-ray and neutron-curve radioactivity well-logging services throughout the Oklahoma division.

Personnel changes in the division are: C. R. Parker from district manager at

Pauls Valley, Okla., to assistant division manager under W. L. Carwile in Oklahoma City; R. B. Burns from assistant district manager at Ardmore, Okla., to district manager at Pauls Valley; Larry Drake has joined the company from Well Perforators, Inc., as sales engineer at Ardmore.

Another change in the Oklahoma oil area is the purchase of Well Perforators, Inc., by Welex. The reorganization and expansion of Welex Oklahoma division makes it possible for the company not only to serve operators which formerly were customers of Well Perforators, but also to give better and more complete service to regular Welex customers.

WILDCAT COMPLETIONS

(Continued from page 379)

Kansas City 3,326-35 ft. TD 3,504 ft. New pool.

Cowley County: Rex & Morris-Sunray Oil Corp. 1 Graham, CWL SW SW 5-30s-5e. TD 2,869 ft.

Finney County: Salina Drilling Co. et al 1 Gano, NW NW SW 24-21s-33w. Dry. TD 5,000 ft.

Graham County: Anschutz Drilling Co. 1 Bolling, SW SW SW 28-9s-25w. Dry. TD 4,450 ft.

Rocket 1 Noah, CSL S½ SW 16-10s-21w. Dry. TD 3,850 ft.

Kingman County: Cities Service Oil Co.-Lion Oil Co. 1 McCartney unit, NW NW NW 8-27s-9w. Dry. TD 4,445 ft.

Beardmore-NCRA 1 Aldrich, NW NW NW 30-30s-7w. Dry. TD 4,703 ft.

McPherson County: Aladdin-Salina 1 Johns, SE SE SE 28-20s-1w. Dry. TD 3,551 ft.

Osborne County: Murfin 1 Madsen, NE NE SE 17-9s-14w. Dry. TD 4,206 ft.

Pawnee County: S. T. Jocelyn et al 1 Lawton, CSL SW NE 22-21s-16w. Dry. TD 3,900 ft.

C. Todd-Vickers 1 Flick, NW NW NW 10-22s-16w. Dry. TD 3,965 ft.

Pratt County: Helmerich and Payne 1 Jorns, SW SW NW 5-26s-11w. Dry. TD 4,354 ft.

Amerada Petroleum Corp. 1 Whitman, SW SE NW 11-27s-12w. Dry. TD 4,636 ft.

Rice County: Vickers and Jayhawk 1 Fail, NW SE SE 31-1s-6w. Dry. TD 3,071 ft.

Russell County: Brooks Pierce 1 Shaffer, SW SW NE 11-13s-15w. Dry. TD 3,305 ft.

Rush County: Fleming & Woodman-Mid Plains 1 Brazoa, SW SW NW 30-19s-16w. Dry. TD 3,858 ft.

Saline County: Beardmore 1 Cooley, NE NE SW 15-16s-1w. Dry. TD 2,675 ft.

Sedgwick County: Stickle et al 1 Farber, NE NE NW 32-29s-2e. Dry. TD 3,600 ft.

Sheridan County: T. Allan et al 1 Godfrey, SW NW NE 25-6s-29w. Dry. TD 4,100 ft.

Stafford County: Lewis Drilling Co. 1 Moulds, NE NW NE 23-23s-12w. Dry. TD 3,880 ft.

Honaker 1 Suiter, SW SW NW 20-24s-15w. Dry. TD 4,508 ft.

Sumner County: The Texas Co. 1 Mears, SE SE SE 19-32s-4w. Dry. TD 4,731 ft.

NEBRASKA

Cheyenne County: G. H. Chizum 1 McMillan, NW NW NE 34-14n-51w. IPP 360 BOPD, "J" sand discovery, new field. "J" sand 5,045 ft. TD 5,094 ft.

James P. Sloss 1 Larson, NW NW NW 30-14n-52w. Dry. TD 5,640 ft.

Yale Lewis 1 Rexroth, NE NE SE 13-15n-48w. Dry. TD 4,580 ft.

Ralph Lowe 1 Lindberg, NE NE 29-18n-47w. Dry. TD 3,950 ft.

CALIFORNIA

Fresno County: Seaboard Oil Co. 36-22 Government, 22-16s-13e. Dry. TD 5,694 ft.

Kern County: Universal Consolidated Oil Co. 25 Conoco, 21-25s-20e. Dry. TD 3,270 ft.

Terminal Oil Co. 1 Williams, 35-29s-21e. Dry. TD 3,534 ft.

Standard Oil Co. 338-29D "Well," 29-32s-24e. Dry. TD 5,620 ft.

R. B. Watkins 1 Jean, 26-28s-28e. Dry. TD 3,118 ft.

Ferguson & Bosworth 1 Wallace-Hood-USL, 24-29s-20e. Dry. TD 901 ft.

Standard Oil Co. 37 Tejon 3, SE SW 21-11n-18w. IPP 12 BOPD, 30°, TD 1,493 ft. (New V-6 zone discovery in Tunis Creek field.)

Ferguson & Bosworth 2 Wallace-Hood-USL, NE NE 24-29s-20e. IP 8 BOPD, 40 BWPD, perforations 490-533 ft. TD 546 ft. (New field discovery in Westrich anticline area.)

Los Angeles County: General Petroleum Corp. 3 N.L.&F., 20-4n-17w. Dry. TD 11,497 ft.

* Orange County: Shell Oil Co. 12 Menchego, NE NE 1-3s-10w. IPP 55 BOPD, perforations 7,731-7,769 ft. TD 10,019 ft. (Deeper zone discovery and extension to Tonner Canyon area of Brea-Olinda field.)

* Drilling & Exploration, Inc. 1 Drilexco-State-Stern, NE SE 32-3s-9w. IPP 251 BOPD, 19.7°, perforations 4,050-4,985 ft. in Kraemer zone. TD 4,985 ft. (New pool discovery on south edge of Richfield field.)

San Bernardino County: Lee Drilling Co. 1 Lee, 33-2s-8w. Dry. TD 913 ft.

San Luis Obispo County: Ohio Oil Co. 1 J. A. Pierce, 12-25s-12e. Dry. TD 4,594 ft.

Santa Barbara County: Amerada Petroleum Corp. 1 Sudden, 24-6n-36w. Dry. TD 1,884 ft.

MONTANA

Yellowstone County: Cities Service Oil Co. 1 State, C SW SW 16-2n-25e. Dry. TD 5,536 ft. Ordovician 5,230 ft.

WYOMING

Niobrara County: W. A. Newton et al 1 Roy Johnson, SE NE SE 13-36n-64w. Dry. TD 4,349 ft. Lakota 4,278 ft.

Park County: The California Co. 1 Rawhide unit, NW SW SE 4-48n-101w. IPP 75 BOPD, Phosphoria discovery, new field. Phosphoria 5,038 ft. TD 6,200 ft. Madison 5,713 ft. PB 5,257 ft.

UTAH

Emery County: Delhi Oil Corp. 1 Russell, C SW SW 34-25s-12e. Dry. TD 6,008 ft. Devonian 5,990 ft.

COLORADO

Adams County: Forest Oil Co. 2 State-Hough, SW SE NE 36-1s-57w. IPF 25,000 M.c.f. of gas, 110 BOPD, "J" sand oil discovery, new pool. "J" sand 5,270 ft. TD 5,355 ft.

Logan County: Skelly Oil Co. 1 Frank Svacina, SW SE SE 18-8n-54w. IP gaged 2,740 M.c.f. of gas per day, "J" sand gas discovery, new field. "J" sand 5,370 ft. TD 5,502 ft.

Plains Exploration Co. 1-B State, NE NE SW 23-7n-52w. Dry. TD 4,864 ft.

C. D. Edmonson 1 State, NW NW NE 16-10n-52w. Dry. TD 5,101 ft.

Morgan County: Chittim & Allardyce 1 State, NE NE SW 16-5n-57w. Dry. TD 5,656 ft.

Chittim & Allardyce et al 1 "X" State, NE NE SW 16-5n-57w. Dry. TD 5,934 ft.

Washington County: Woodward Oil Co., Inc. 1 Smith, NE NW NW 31-1s-55w. Dry. TD 5,302 ft.

Walter Dunn & Clifford Somers 1 Crowley, SE SE SW 3-1s-56w. Dry. TD 5,420 ft.

Herndon Drilling Co. 1 Roderick, SW SE SW 32-2s-54w. Dry. TD 5,242 ft.

SASKATCHEWAN

Socony-Woodley-Southern 5-3 Antelope Lake, LSD 4, 5-16-18-3. Oil in Jurassic. TD 4,030 ft. PB 3,422 ft.

Tide Water-Brisbin 1 Crown, LSD 10, 32-20-12w3. Dry. TD 2,761 ft.

Tide Water-Signal-Johnston Lake 2-2 Crown, LSD 2, 2-13-3w3. Dry. TD 5,166.

Shell A-7-18 Midale, LSD 7, 18-6-10w2. IP 400 BOPD, ½-in., Mississippian. TD 5,080 ft. PB 4,640 ft.

ALBERTA

Modoc-Mitmor 1 Hanson, LSD 8, 19-46-17w4. Dry. TD 3,600 ft.

Bay-Kroy 4-6 South Camrose, LSD 4, 6-46-19w4. Dry. TD 4,160 ft.

Shell 1 Westerdale, LSD 10, 4-34-3w5. Oil well. TD 11,600 ft. PB 6,972 ft.

H. B.-Union 2 Heart River, LSD 8, 21-77-16w5. Dry. TD 7,386 ft.

Dragon 13-21 Marwayne, LSD 13, 21-27-9w4. Basal Blairmore gas, IP 12 M.M.c.f. per day. TD 3,956 ft.

Western-Kroy-Triad 1 Kirkpatrick Lake, LSD 4, 17-34-10w4. Dry. TD 3,612 ft.

Widney 1 Vilna, LSD 7, 28-58-15w4. Dry. TD 3,239 ft.

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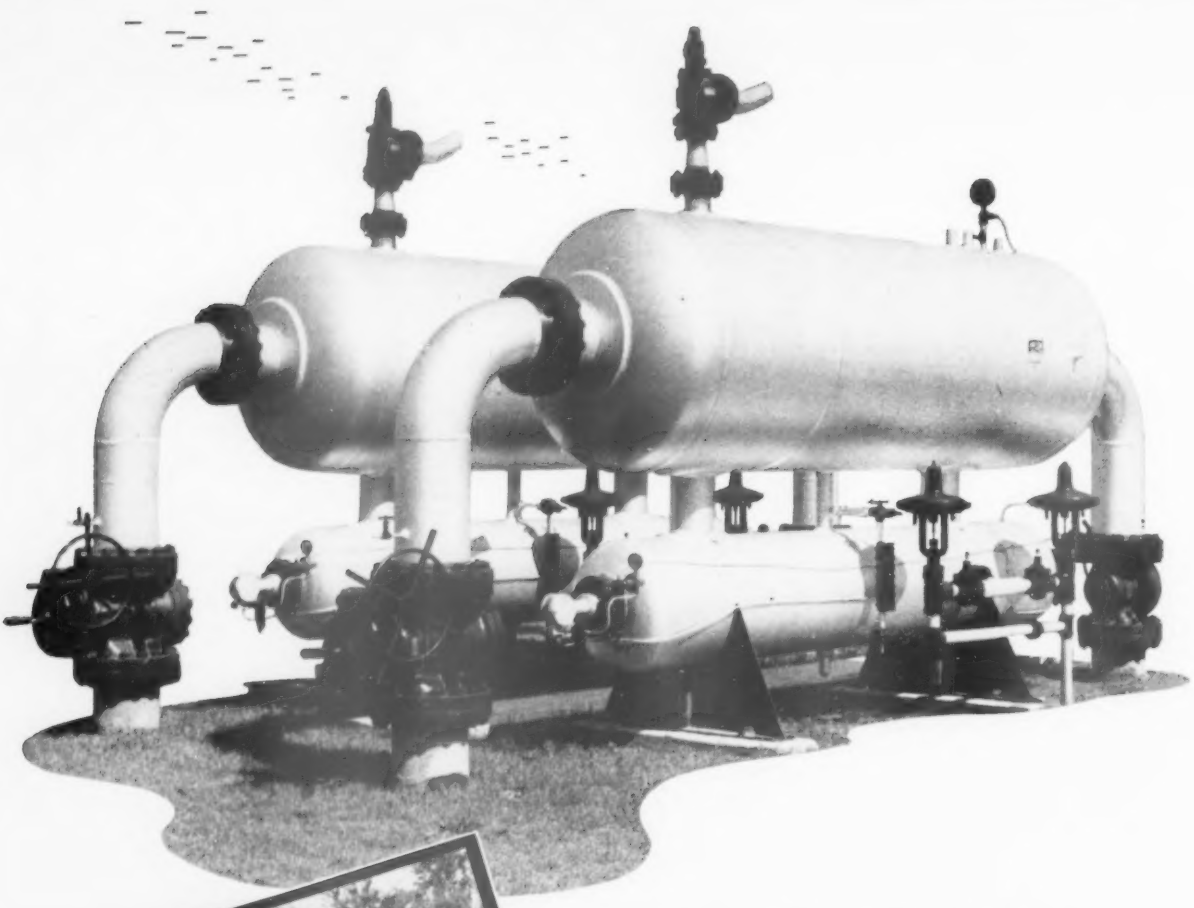
LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that a total of approximately 954.51 acres of acquired lands will be offered in three separate parcels for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 1 p.m. Eastern Standard Time, on July 22, 1953, when bids will be opened. Details of the lease offering, how and where to submit bids, and a copy of the lease form may be obtained upon request from the Oil and Gas Supervisor, U.S. Geological Survey, Roswell, New Mexico, or from the Washington Office of the Bureau of Land Management, Washington 25, D.C. Edward T. Woozley, Administrator.



NATIONAL
HORIZONTAL SCRUBBERS
condition gas at Westwego Installation

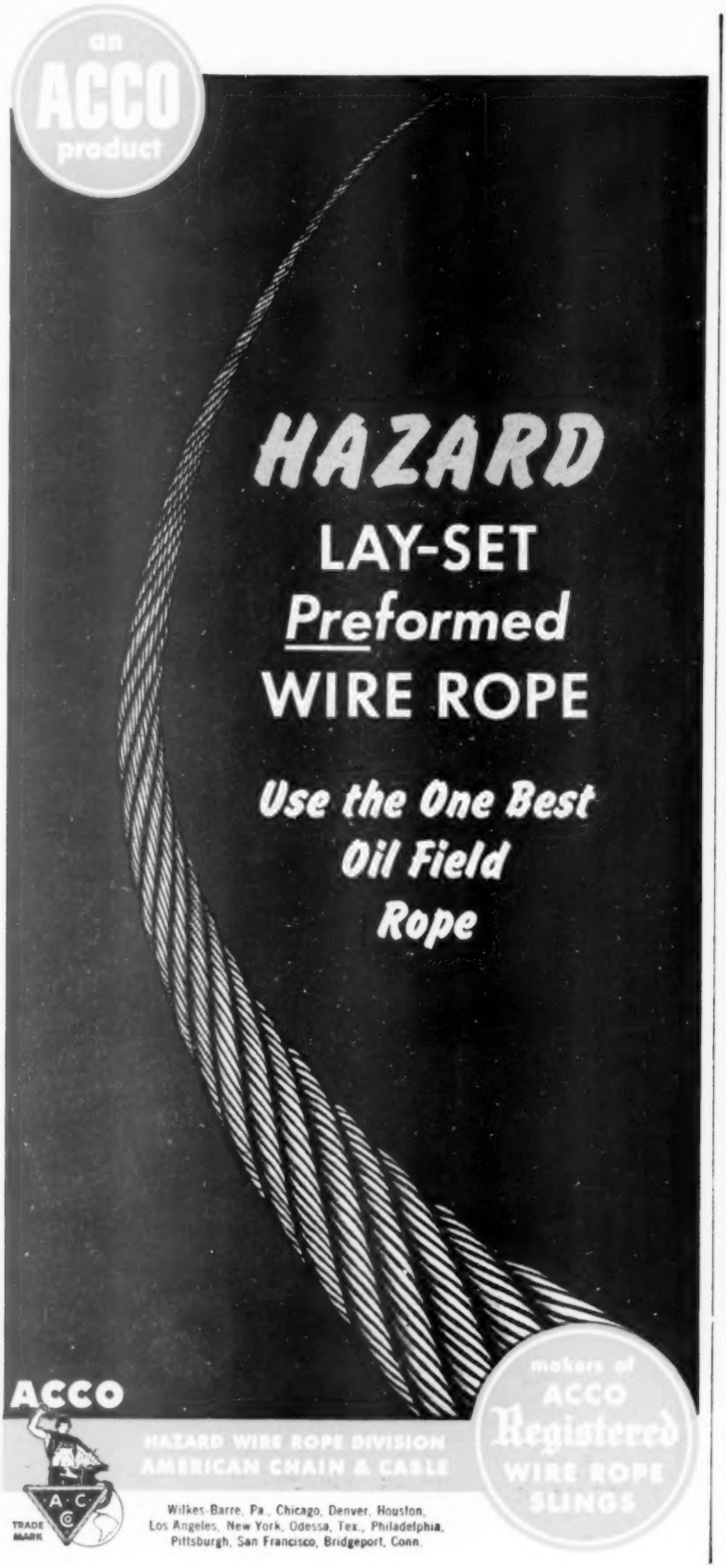
These two 48" x 10' x 500# WP National Horizontal Gas Scrubbers are installed at the Westwego station of the world's largest handler of natural gas. They are efficiently and economically removing liquids, both water and hydrocarbons, to assure the delivery of clean, dry gas to consumers in the New Orleans area. National Horizontal Gas Scrubbers are available in a wide range of sizes, working pressures and capacities to fit the needs of gas producers and carriers.

It's a National

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

9-8-52



DRILLING

Seven Practical Rules Increase Service from Rotary Drilling Lines

The drilling line is one of the most costly expendable items in rotary drilling, so if by following certain recommended practices the driller can increase the life of his line, the cost will be reduced. Here in concise, boiled-down form are seven practical rules for buying and using rotary drilling lines:

1. **Buy only the best** type and grade wire rope. It is false economy to buy any but the best line to meet the severe service requirements of rotary drilling. The best line is 6x19 Seale, improved plow steel with wire core, and of course, preformed.

2. **Buy lines long enough** to allow for sufficient cuts at the drum end. Lengths should be based on practices in your local field. The longer the line, the more ton-miles per foot you'll get.

3. **Set up a uniform number of ton-miles** between cuts so you'll have a basis for evaluating the actual work done since last moving the line to change wear points. This will avoid the need for long cuts to remove worn line sections.

4. **Inspect your line at regular intervals** Avoid unnecessary abuse and excessive wear. Inspect at least once each day, preferably once each tour.

5. **Use drum-type tie-down** so as not to distort or damage a part of the line which will later have to pass through the blocks. The drum-type reduces the time required for cutting the line.

6. **Keep daily ton-mile service records** at the rig. One of the simplest and easiest to use records which we have seen is available without charge through Hazard wire rope distributors. It is a three-cover book with replaceable record pad and provides a permanent record for home office analysis.

7. **Get the advice** of your local Hazard wire rope distributor or Hazard representative. He has had broad experience in selling and servicing rotary drilling lines and can give you information which will save you money. What he has learned in talking with drillers on the wide variety of rigs being used in old and new fields can be worth a great deal. He carries a stock of the popular sizes of drilling ropes and is ready to serve you at any time.

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